Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2010
Unlicensed Intentional Radiators

on the

Elkay EZ Bottle Filler and Fountain (unfiltered)

Raymond Lee Au, B.Eng
Project Engineer
Global EMC Inc.
11 Gordon Collins Dr.
Gormley, ON
L0H 1G0, Canada
Ph: (905) 883-8189

Testing produced for

ELKAY

Elkay Manufacturing Co.

See *Appendix A* for full customer & EUT details.

Industry Canada

LAB REGISTRATION #6844A-3

FCC REGISTRATION #377448

ACCREDITED

Testing Laboratory Certificate #2555.01

Table of Contents

Report Scope

This report addresses the EMC testing and test results of the Elkay NextGen unfiltered drinking fountain. This unit is herein referred to as EUT (Equipment Under Test). Testing is performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 8:2010
FCC Part 15 Subpart C:2014

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	Elkay Manufacturing Co.
Product	EZ Bottle Filler and Fountain (unfiltered)
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	2AC8R-EZWSNA
EUT Industry Canada Certification #, IC:	12430A-EZWSNA
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Raymond Lee Au

Client	Elkay Manufacturing Co.
Product	EZ Bottle Filler and Fountain (unfiltered)
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-Gen	Restricted Bands for intentional operation	QuasiPeak Average	Pass See Justification
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-Gen	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)1 RSS-210 A8.1(b)	Channel carrier separation	> 20dB Bandwidth	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	20dB BW < 250 kHz	≥ 50 channels	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	Average time of occupancy	≤ 0.4s/20s	Pass
FCC 15.247(a)(1)i RSS-210 A8.1(c)	Max 20dB Bandwidth	≤ 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(1)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(g) RSS-210 A8.1	FHSS compliance	Complies using continuous data.	Pass
FCC 15.247(h) RSS-210 A8.1	FHSS intelligence	LBT used. No other coordination used.	Pass
Overall Result			**PASS**

All tests were performed by Raymond Lee Au.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Justifications, Descriptions, Deviations & Notes

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the antenna in this device is inside the unit's enclosure, and is not meant to be replicable by the user

For the Restricted Bands of operation, the transmitter is designed to operate between 902.7 MHz and 927.3 MHz.

The EUT is not a hybrid system; FCC 15.247 (f) does not apply.

The EUT was tested in the upright position as it will be installed during use.

The antenna gain for the 15.247 transmitter is < 6dBi.

There are 2 versions of the EUT. They have identical RF control boards located in the lower, base part of the unit. This is coupled with an alpha-numeric display panel to display messages. The display panel connects to the base part via a cable harness, and does not have RF components itself. The difference is one has a single water output nozzle on the base (the single level unit), and the other, (the bi-level unit), has two nozzles, the second of which is mounted on a separate base which does not have a display, RF, or any other electrical components. It only has plumbing differences to supply the second nozzle with water. All electrical components of both versions are on a single base with the display. All RF testing is performed on the common base of the unit, and then verification testing is additionally performed with the display connected. Since the bi-level unit has identical electrical parts located in the same positions, the test results are considered to apply for both versions. See *Appendix A* for the model numbers of the units.

Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS-GEN	General Requirements and Information for the Certification of Radio Apparatus
RSS 210:2010	- Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8 dB

Document Revision Status

Release 1 - November 28, 2014
Initial release.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiallary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Sept. 2 – 5 , 2014	All	RA	20-25ºC	30-45%	100 -103kPa

Detailed Test Results Section

20dB Bandwidth of Frequency Hopping Systems

Purpose

The purpose of this test is to find the 20dB bandwidth occupied by a hopping channel. The energy contained within the 20dB bandwidth must remain within the channel in which it transmits. This helps ensure the utilization of the frequency allocation is sufficiently narrow, and is not occupying excessive spectrum. It also helps to prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information

Limits & Method

The limits and requirements are as specified in FCC 15.247(a)(1)i & RSS-210 A8.1(c).

These include the following:

1. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

2. For frequency hopping systems operating in the 902-928 MHz band:

    a. If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

    b. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

3. For frequency hopping systems operating in the 902-928 MHz band:

    a. If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

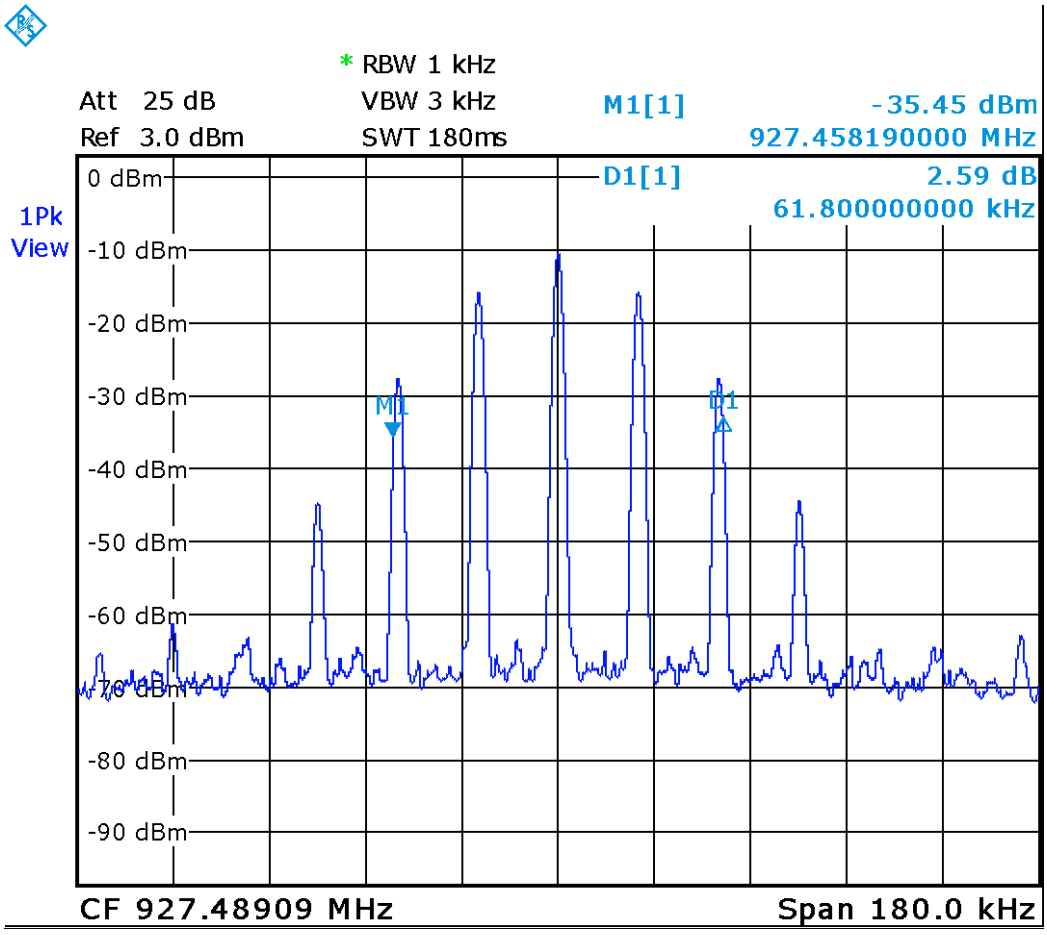
    b. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

The method is described in ANSI C63.10, 6.9.1.

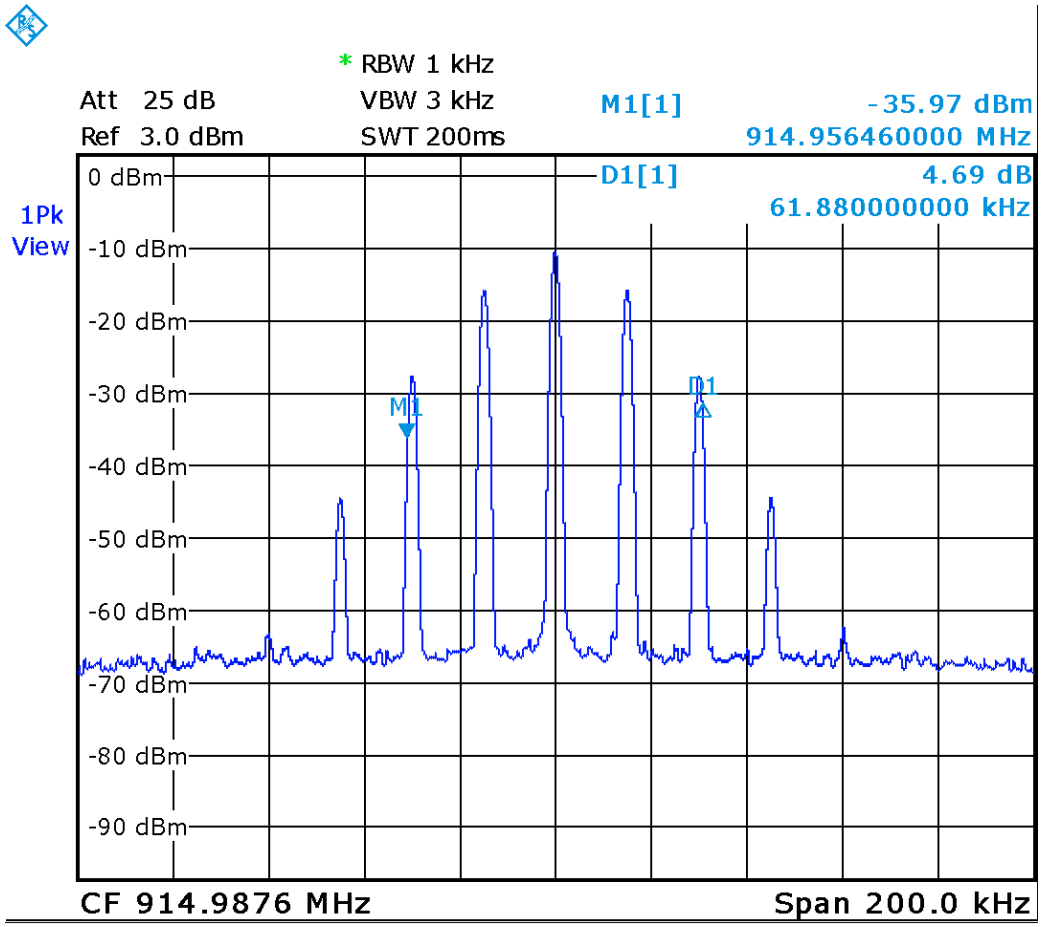
Max 20dB Bandwidth

The graphs below show the 20dB bandwidth during the operation of the device. This is measured by a max hold on the spectrum analyzer and a video bandwidth at least 3x the resolution bandwidth. Bandwidths are shown for low, middle and high channels. These measurements are peak measurement. The EUT is set to transmit continuous modulated data at maximum power.

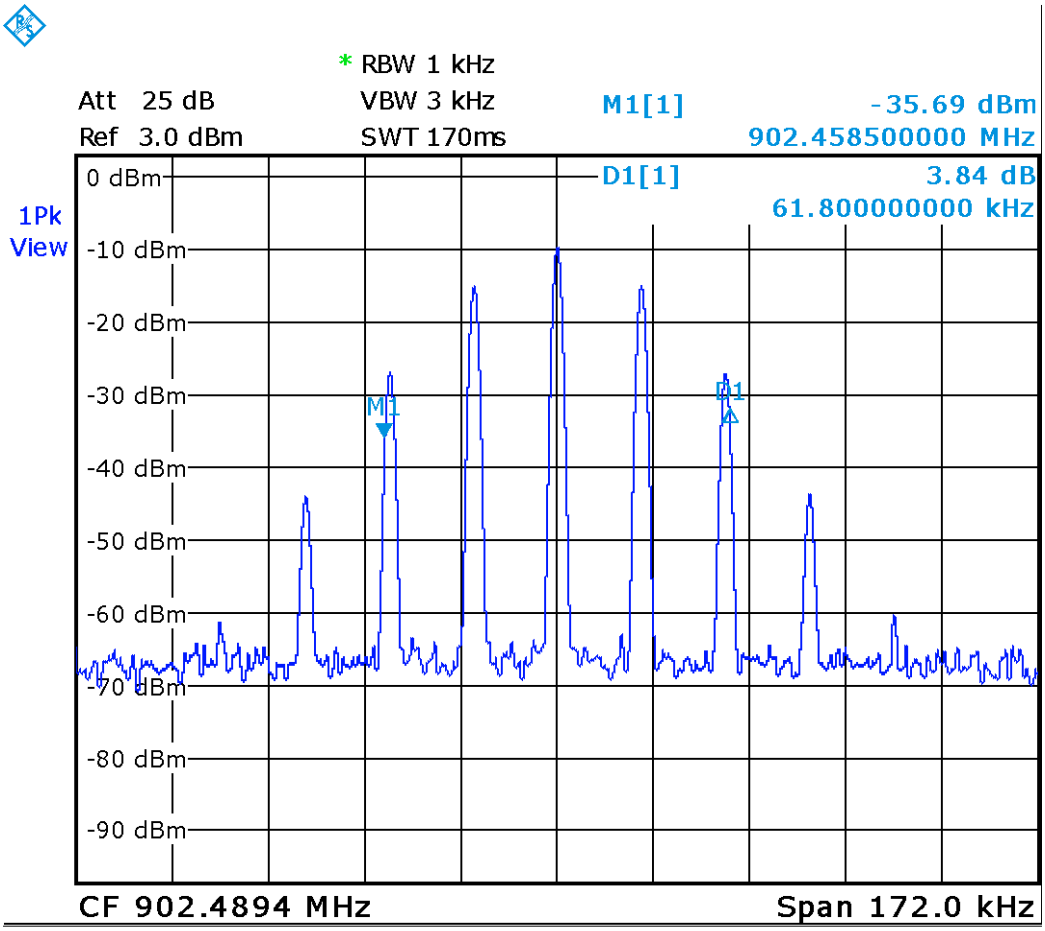
High Channel
20dB BW = 61.8 kHz



Mid Channel
20dB BW = 61.88 kHz



Low Channel
20dB BW = 61.8 kHz

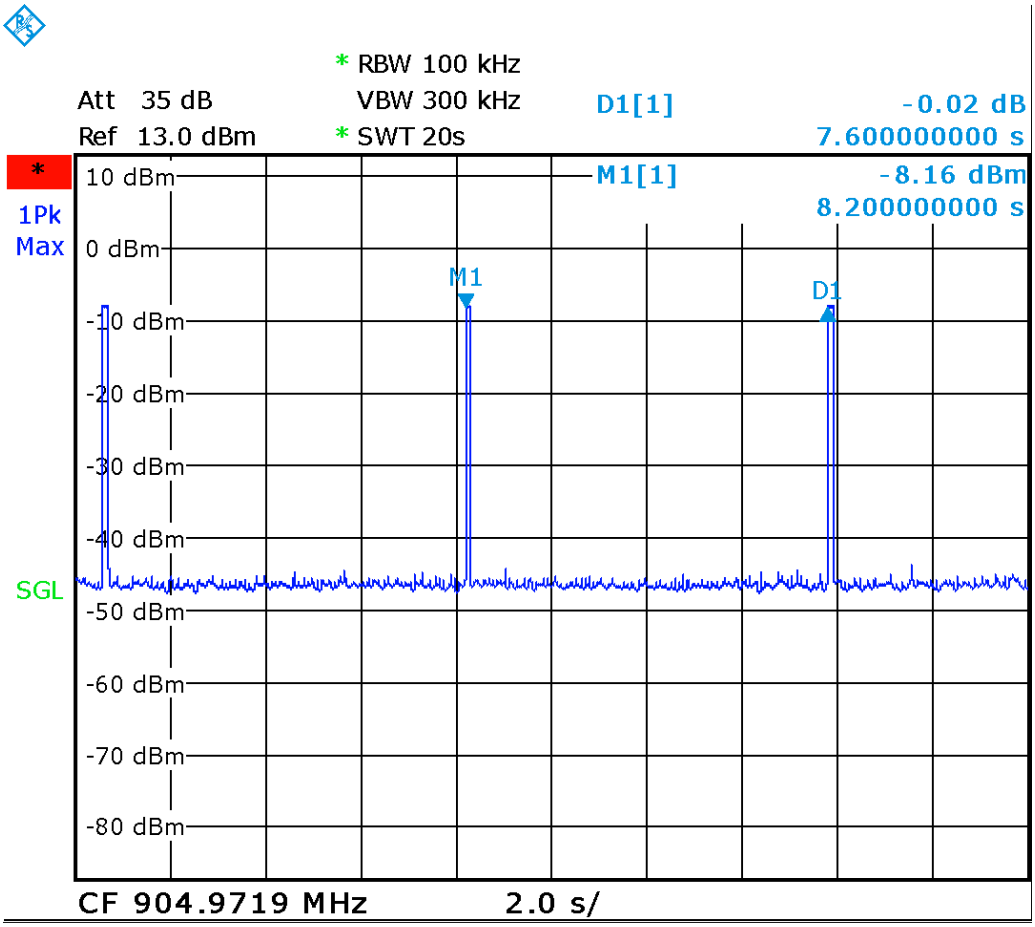


Average Time of Occupancy

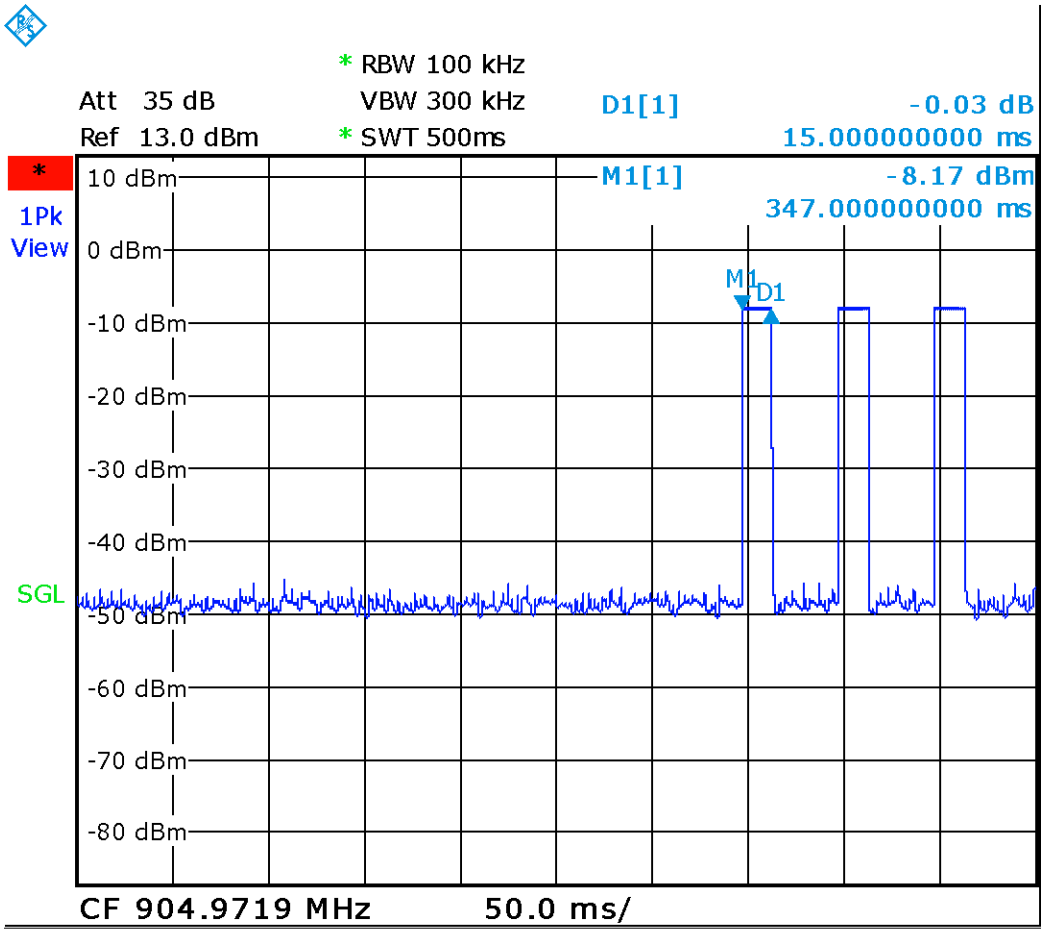
The following plots show the time of occupancy in a channel.

Before Locking With Base Station

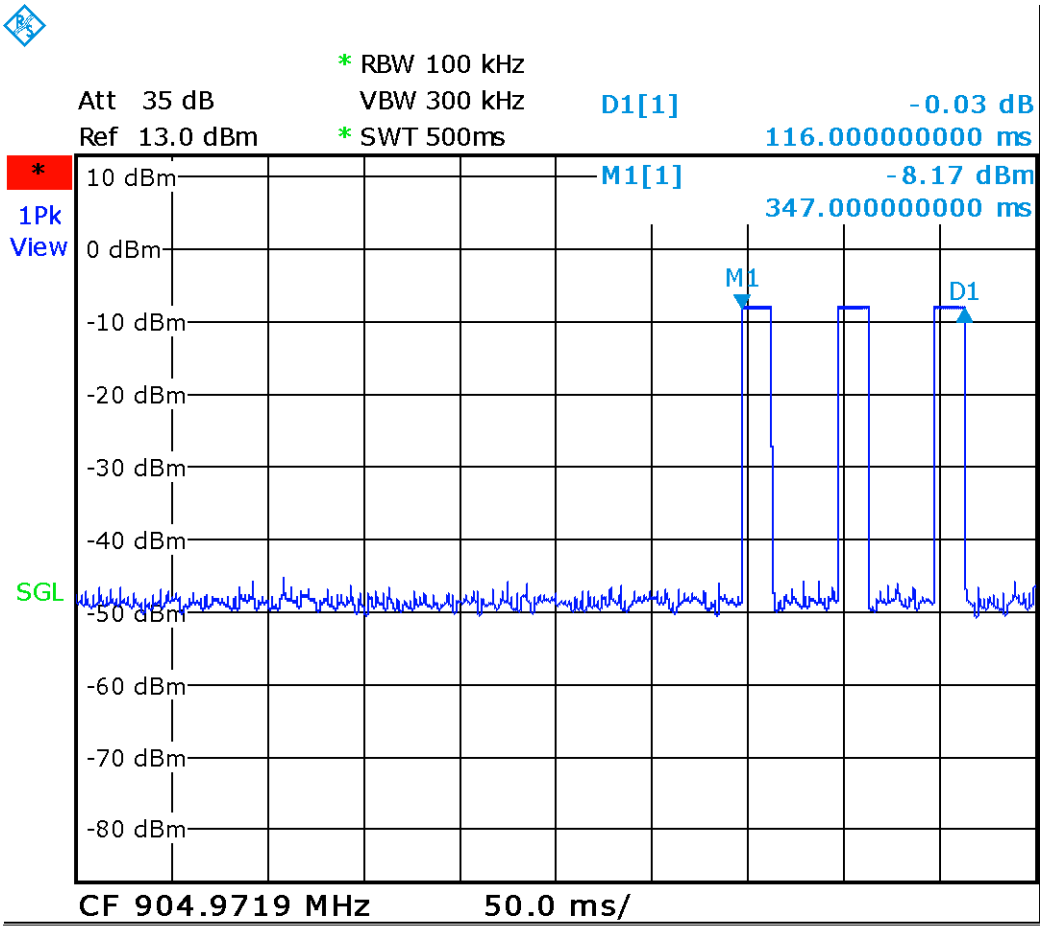
Transmissions in a channel within a 20s time window.
Transmissions are 7.6s apart.
Maximum number of transmissions in 20s = 3



Transmission on time.
Each transmission pulse = 15ms



Maximum number of transmissions per dwell time = 3
The total on time for each dwell time = 15ms x 3 = 45ms

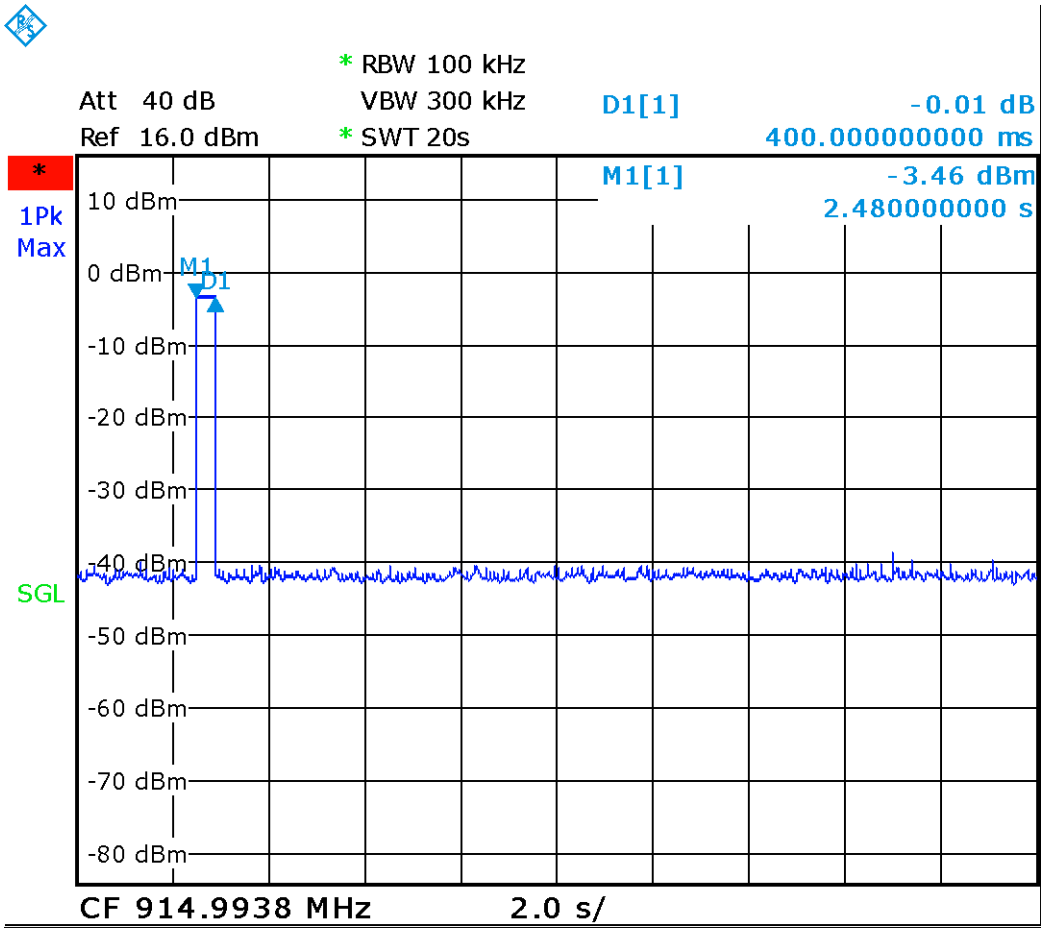


(On time for each transmission) x (Maximum number of transmissions in 20s)
= 45ms x 3 = 135ms = 0.135s < 0.4s.

Note:
Total time required for 3 transmissions = 116ms. Transmitter does not transmit within 16ms to the next frequency hop, or within 4ms after hopping. The dwell time of 150ms as stated by the manufacturer is confirmed.

After Locking With Base Station

The unit synchronizes with the base station's hopping with a 400ms dwell time.
Maximum number of transmissions in 20s = 1



Number Of Channels

The number of channels used by the EUT. is shown in the section titled *Channel Carrier Separation for Frequency Hopping Systems*. The EUT uses 50 hopping channels.

Note: See photo exhibits for photos showing the test set-up.

Results

The EUT passed. The maximum 20 dB BW measured was 61.88 kHz. The EUT uses 50 hopping frequencies, and the time of occupancy on a channel is less than 0.4 seconds within a 20 second period.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov. 15, 2013	Nov. 15, 2015	GMEC 160

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Peak Envelope Conducted Power - FHSS

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in FCC Part 15.247(b)2 and RSS 210 A8.4(1).

1. For frequency hopping systems operating in the 902-928 MHz band:

    a. For systems employing at least 50 hopping channels: 1 watt

    b. For systems employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watts

.

Results

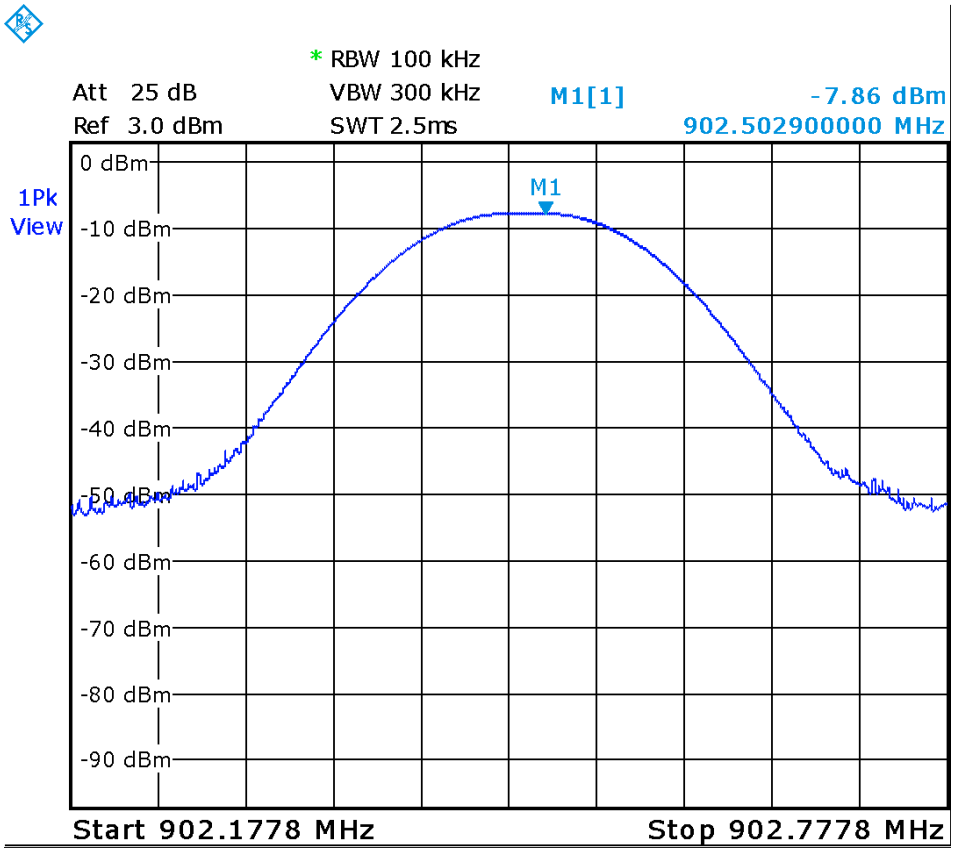
The EUT passed. The peak power measured is 12.4 dBm (17.4 mW).

Table(s)

The table below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Peak detector was used with max hold. The EUT was transmitting continuous modulated data at maximum output power.

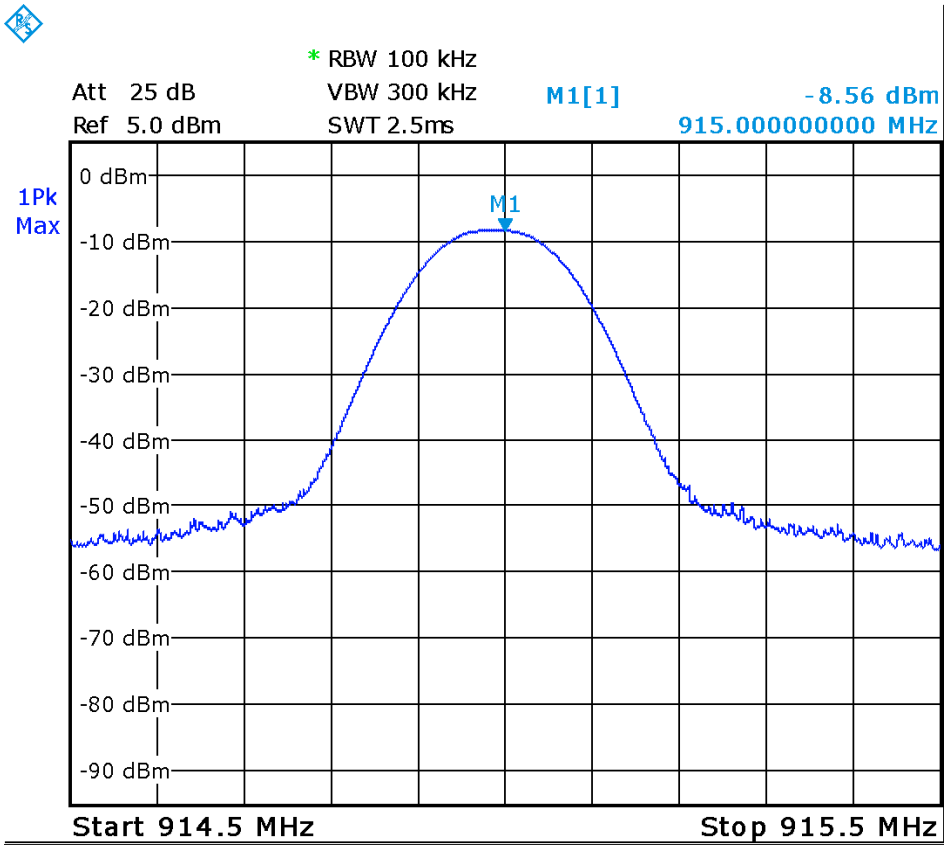
Maximum Peak Envelope Conducted Power – Table 1

Band	Channel	Frequency (MHz)	Received Reading (dBm)	External Attenuation (dB)	Cable loss (dB)	Output Power (dBm)
Low	37	902.7	-7.9	20	0.3	12.4
Middle	21	915.0	-8.6	20	0.3	11.7
High	39	927.3	-8.5	20	0.3	11.8



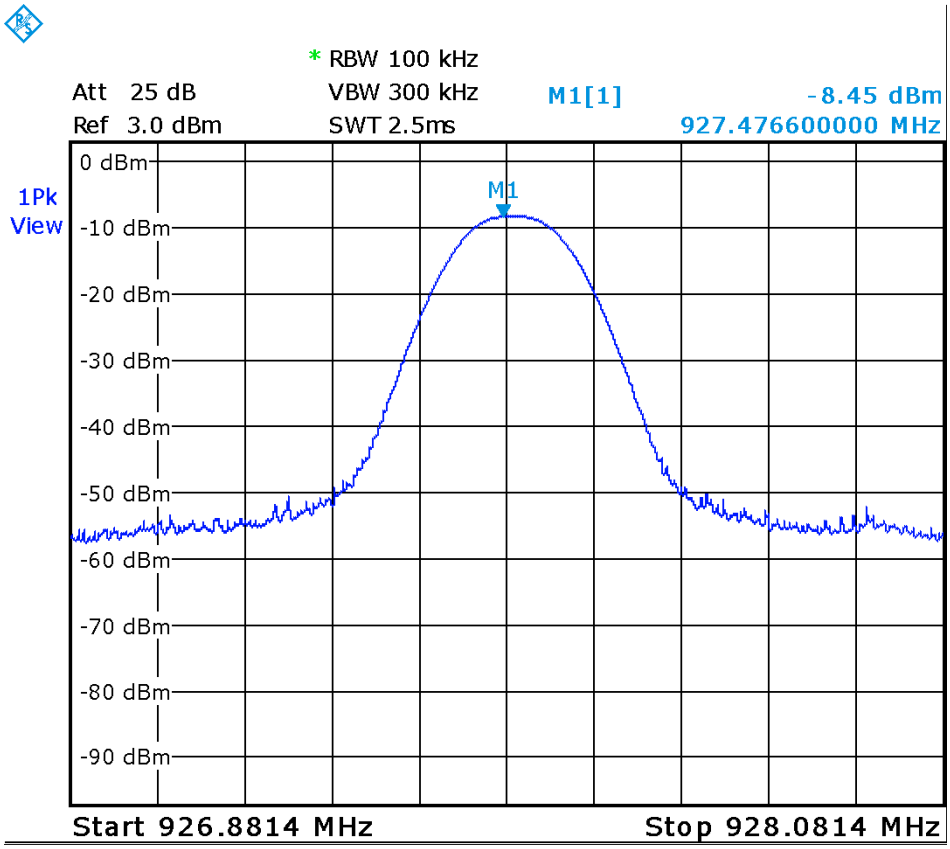
Low Channel

Note: 20 dB for external attenuation losses added to value shown above.



Mid Channel

Note: 20 dB for external attenuation losses added to value shown above.



High Channel

Note: 20 dB for external attenuation losses added to value shown above.

Note: See photo exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	2013-11-15	2015-11-15	GMEC 160
Power Head	PH 2000	AR	2013-02-07	2015-02-07	GEMC 15
Power meter	PM 2002	AR	2013-02-07	2015-02-07	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Channel Carrier Separation for Frequency Hopping Systems

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)1 and RSS-210 A8.1(b).

1. Frequency hopping systems in the 902 MHz - 928 MHz band shall have hopping channel carrier frequencies separated by a minimum of:

The greater value of:

a. 25 kHz,

or

b. The 20 dB bandwidth of the hopping channel,

The 20 dB BW of the system was measured to be 61.88 kHz.

Channels must be separated by at least 61.8 kHz.

Additionally, the EUT must use at least 50 hopping channels as specified by FCC 15.247(a)(1)i & RSS-210 A8.1(c).

Results

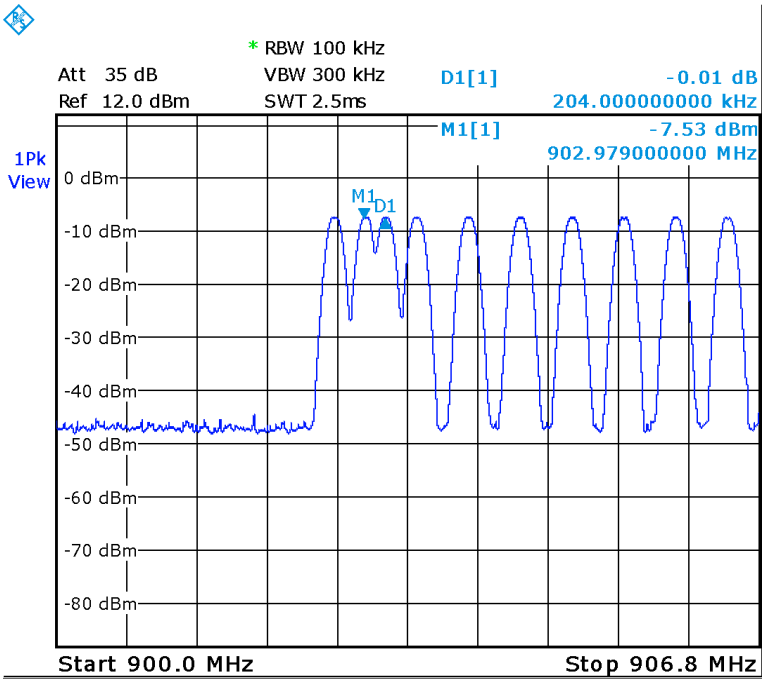
The EUT passed the requirements of channel carrier separation, and exceeds the 20 dB BW of the EUT. The 20 dB BW was measured to be 61.8 kHz, and the device has a channel spacing of at least 201.1 kHz. The EUT also uses at least 50 hopping frequencies.

Graph(s)

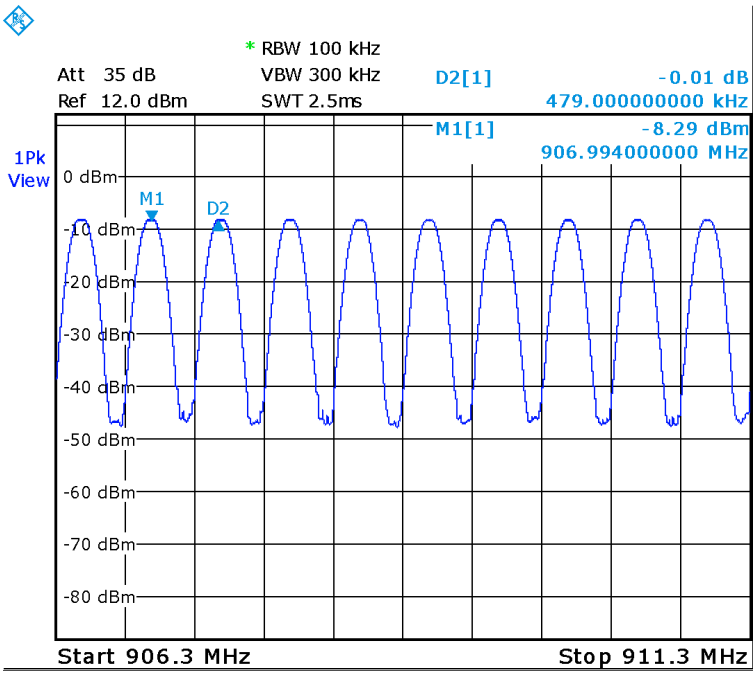
The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer with peak detector function. 20 dB of external attenuation is used at the spectrum analyzer input. Max hold is performed for a duration of not less than 1 minute. The EUT is transmitting at maximum output power with frequency hopping enabled.

Markers in the following plots are set between the closest adjacent channels in the plot.

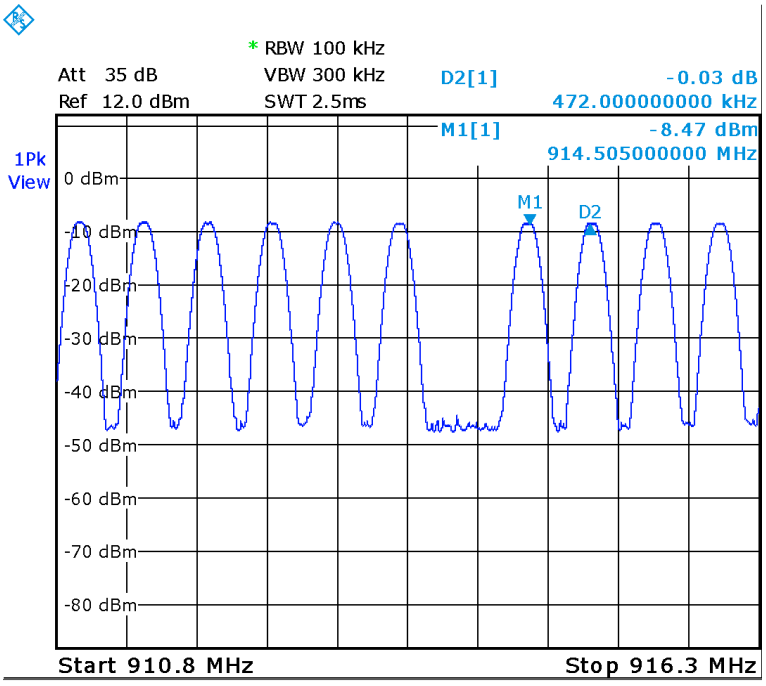
Channel Separation
900 MHz – 906.8 MHz



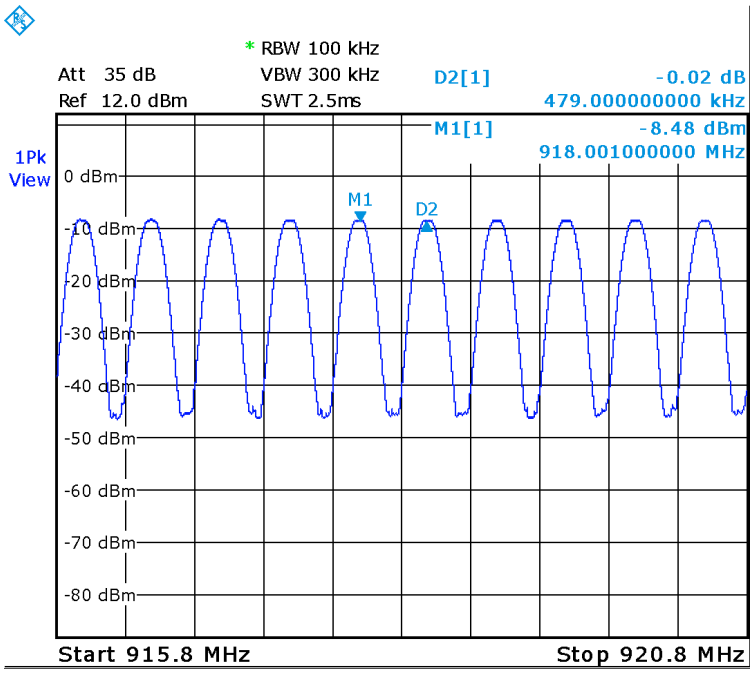
Channel Separation
906.3 MHz – 911.3 MHz



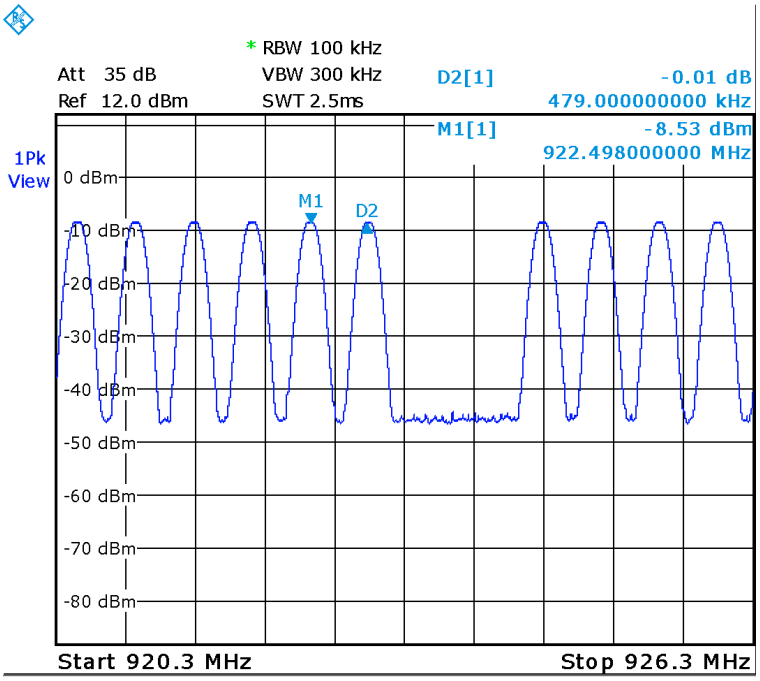
Channel Separation
910.8 MHz – 916.3 MHz



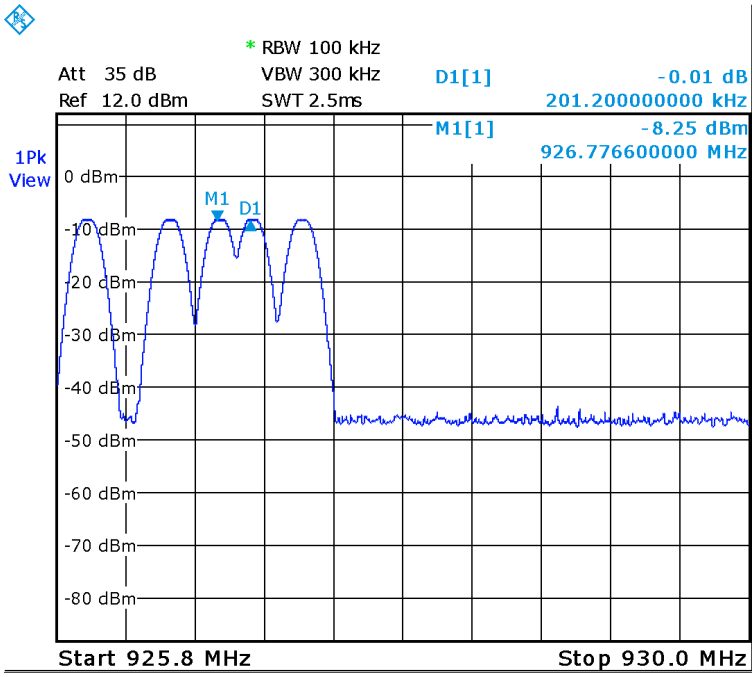
Channel Separation
915.8 MHz – 920.8 MHz



Channel Separation
920.3 MHz – 926.3 MHz



Channel Separation
925.8 MHz – 930 MHz



Note: See photo exhibits for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	2013-11-15	2015-11-15	GMEC 160
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

The limits are defined in 15.247(d) and RSS-210 A8.5. In any 100 kHz band outside the frequency band in which the intentional radiator is operating, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious conducted emissions are to be evaluated up to the 10^{th} harmonic. This -20 dBc requirement also applies at the 'band edge' or 902 MHz and 928 MHz

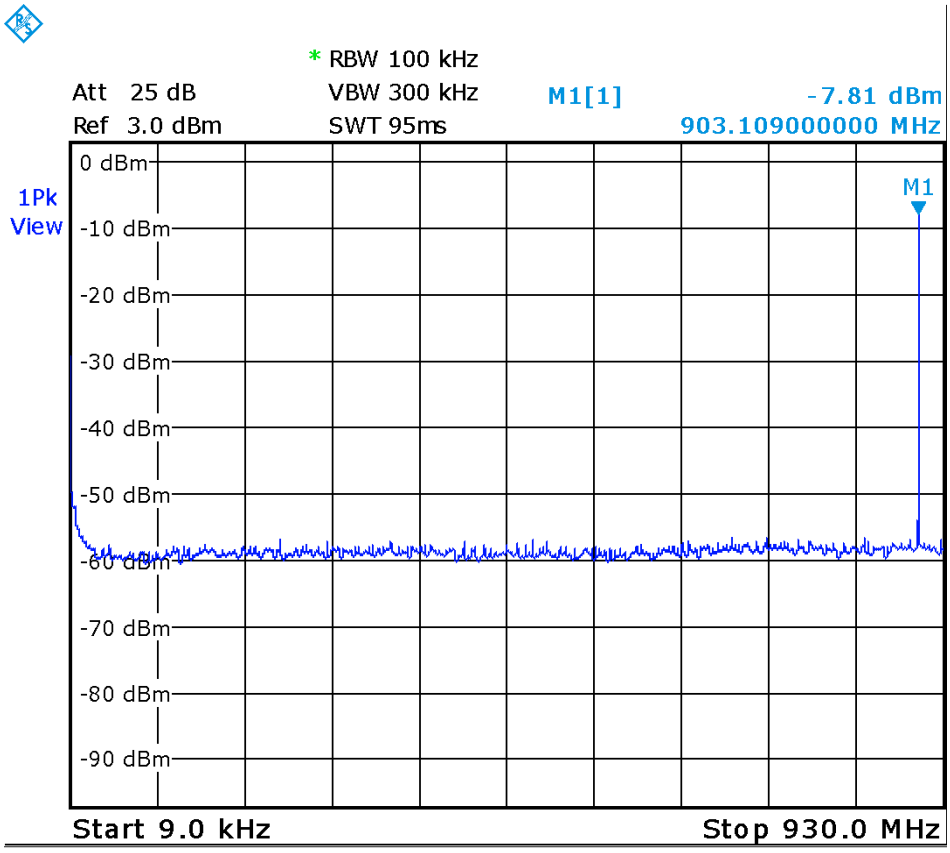
Results

The EUT passes. Low, middle and high band was measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 902 MHz in the low band, and for the high band edge at 928 MHz in the high band.

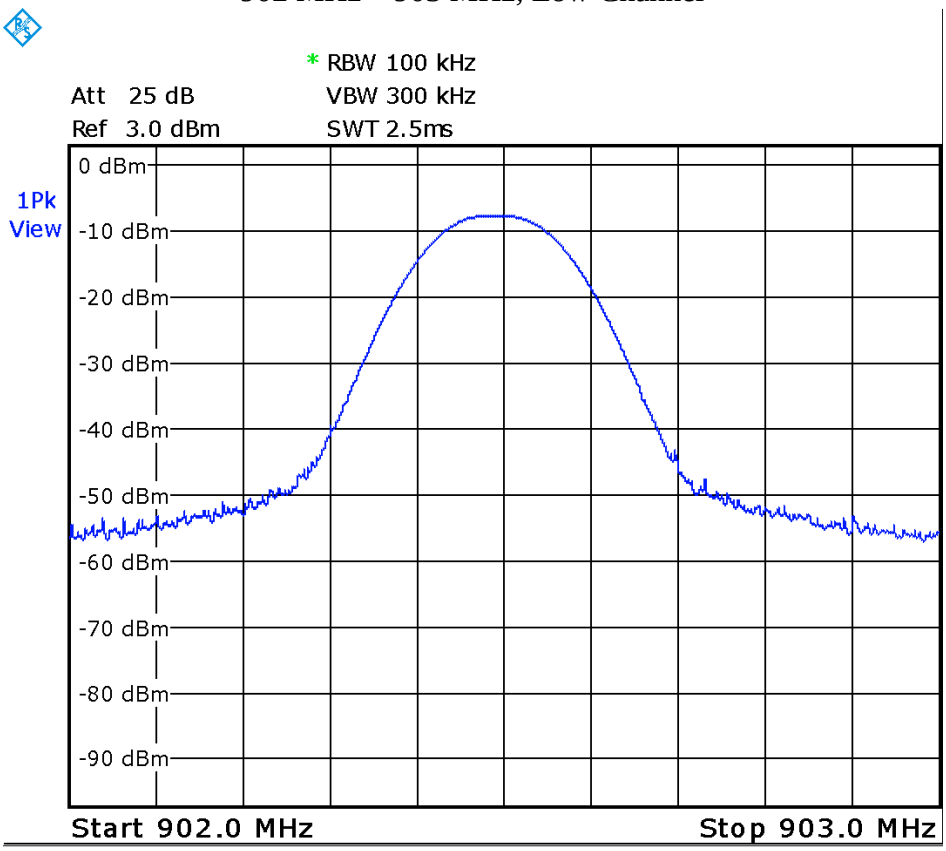
Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT at max output power, continuous transmission of data. Note there was 20 dB of external attenuation during this measurement.

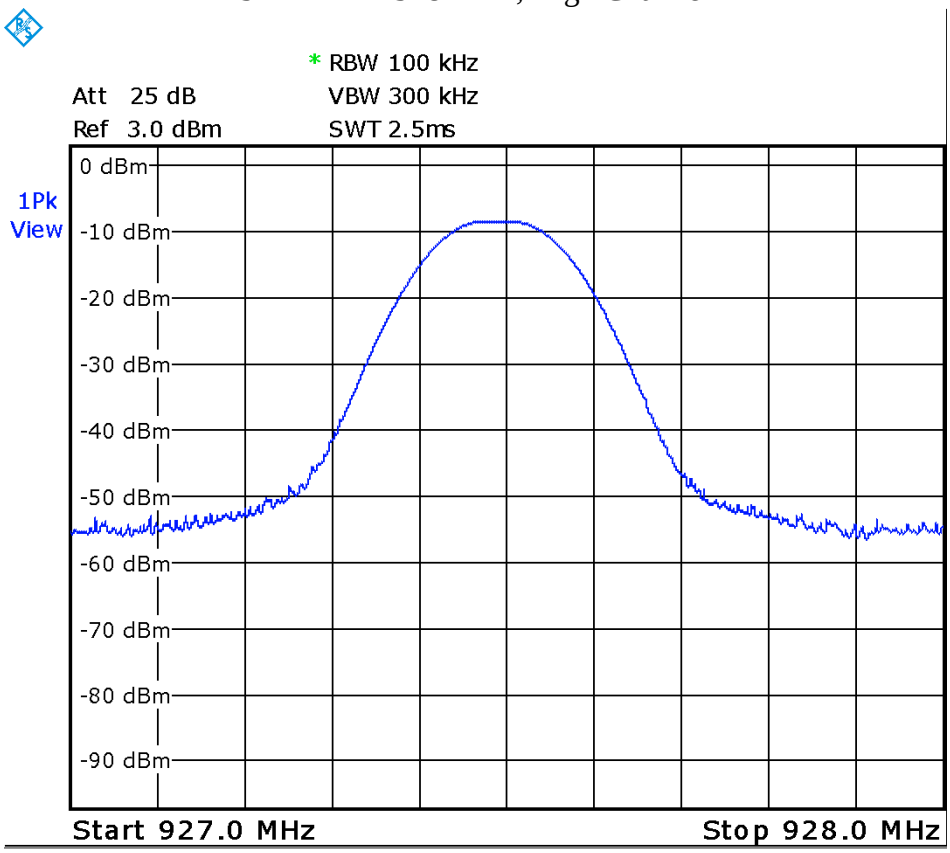
Frequencies below fundamental
9 kHz – 930 MHz, Low Channel



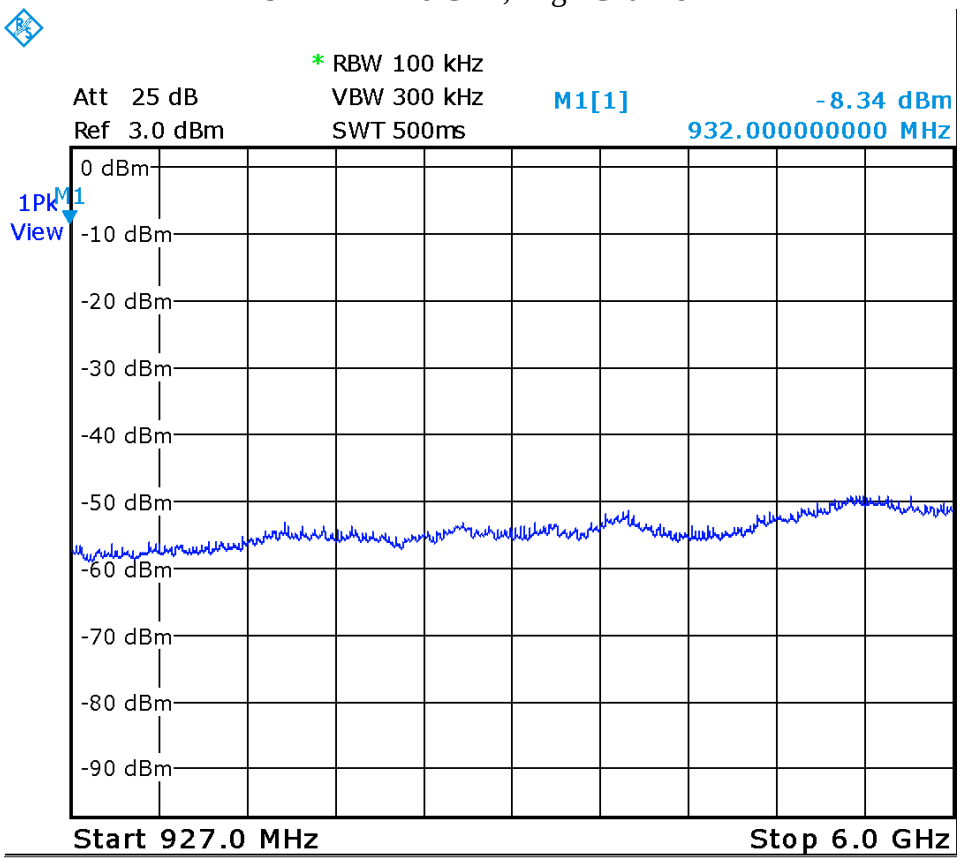
Low Channel, Lower Band Edge
902 MHz – 903 MHz, Low Channel



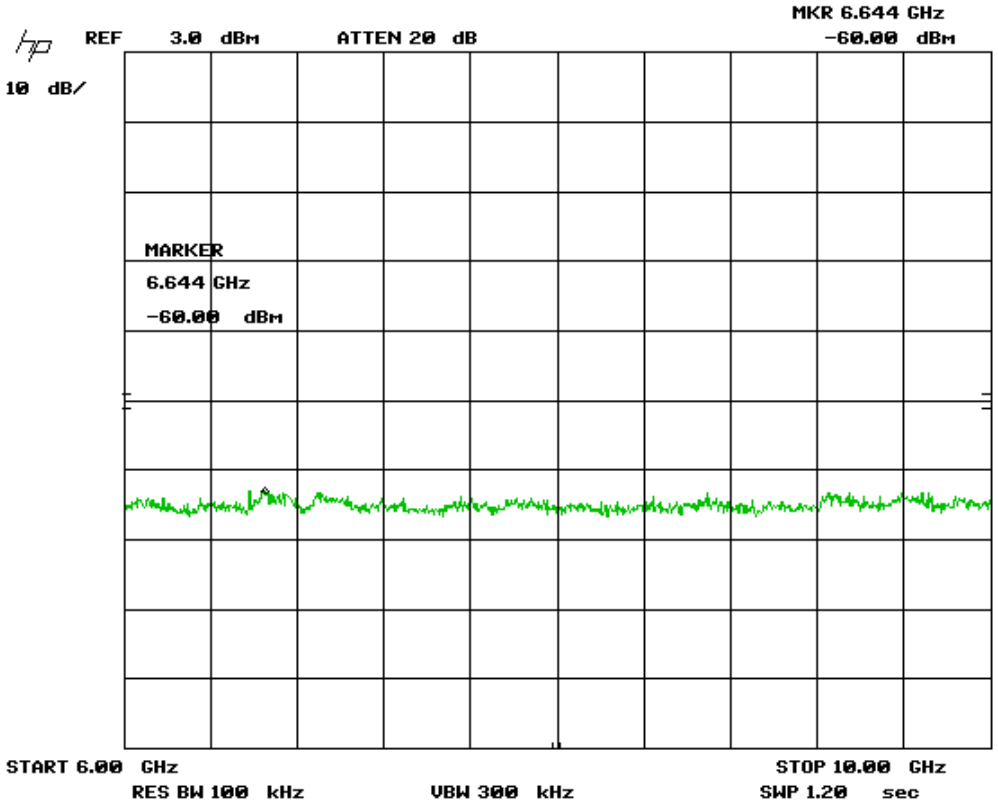
High Channel, Upper Band Edge
927 MHz – 928 MHz, High Channel



Frequencies above fundamental
927 MHz – 6 GHz, High Channel



Frequencies above fundamental
6 GHz – 10 GHz, High Channel



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2013-01-22	2015-01-22	GEMC 169
Quasi Peak Adapter	85650A	HP	2013-01-23	2015-01-23	GEMC 170
Spectrum Analyzer	ESL6	Rohde & Schwarz	2013-11-15	2015-11-15	GEMC 160
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Radiated Emissions – 15.247, 15.209

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

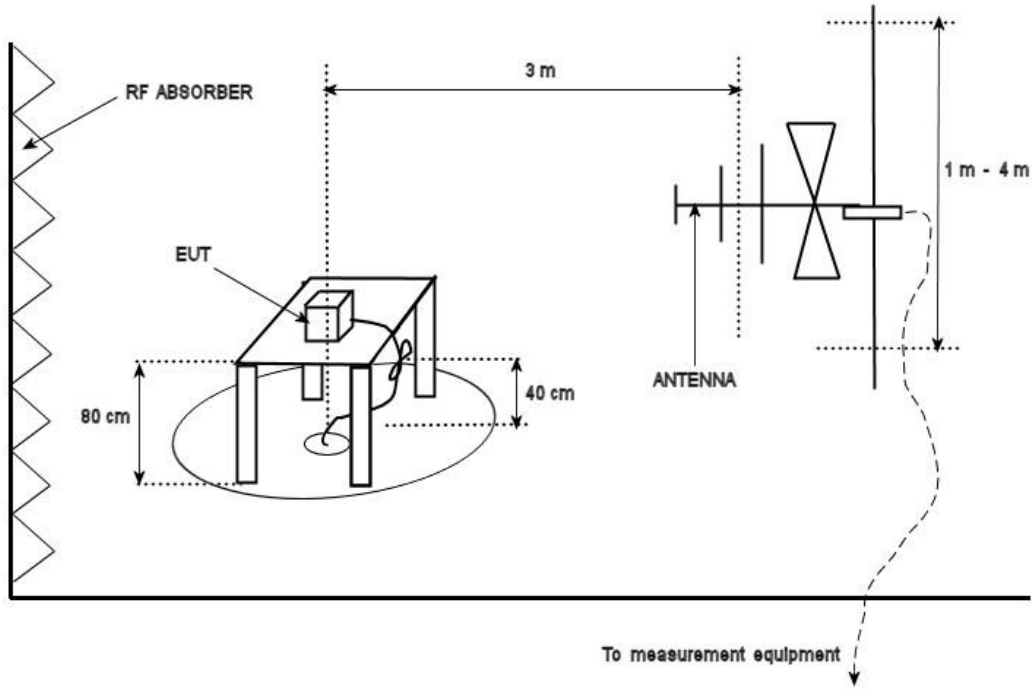
The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.209 and RSS-GEN:

The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m[1]
0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m[1]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[1]
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m[3]) at 3m

[1]Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector.
[3]Limit is with 1 MHz measurement bandwidth and using a Peak detector.

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic.

Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m/3m) is applied.

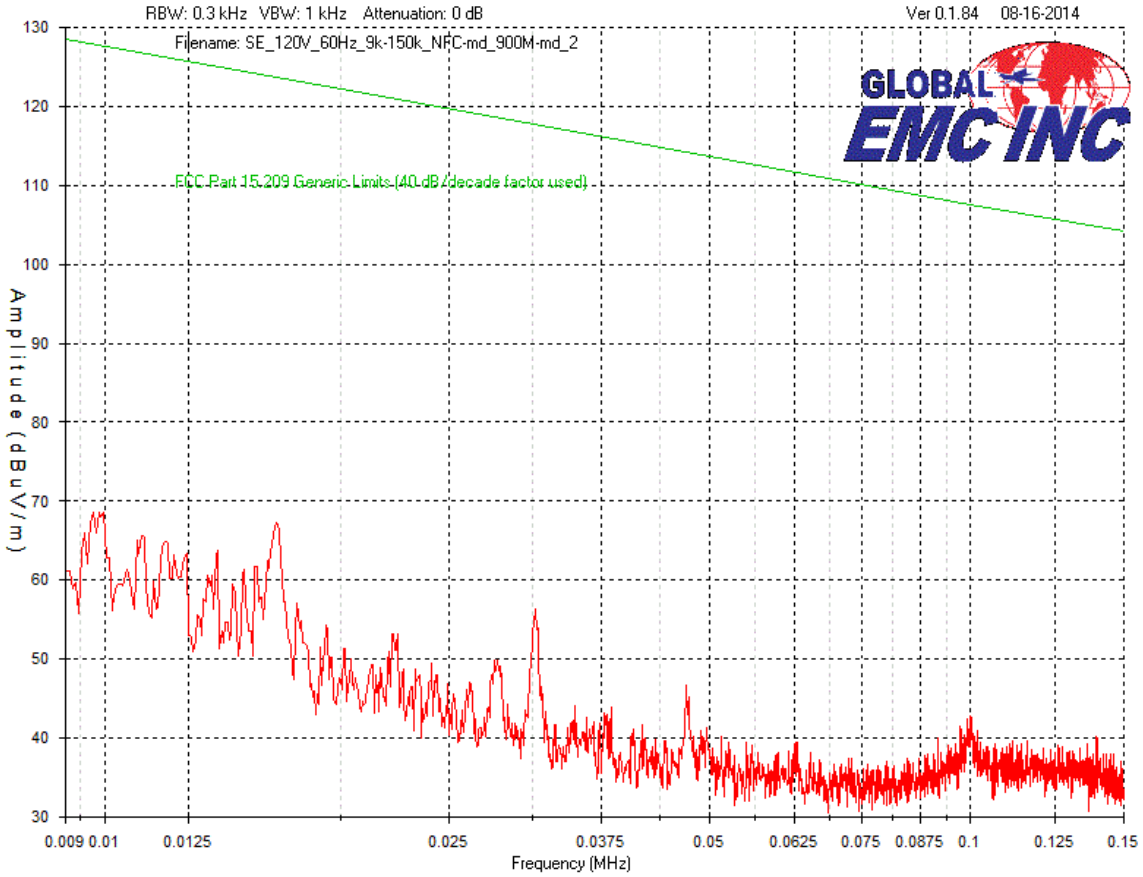
See final measurement section for all measurements.

Low, middle, and high channels were scanned. Worst case is presented.

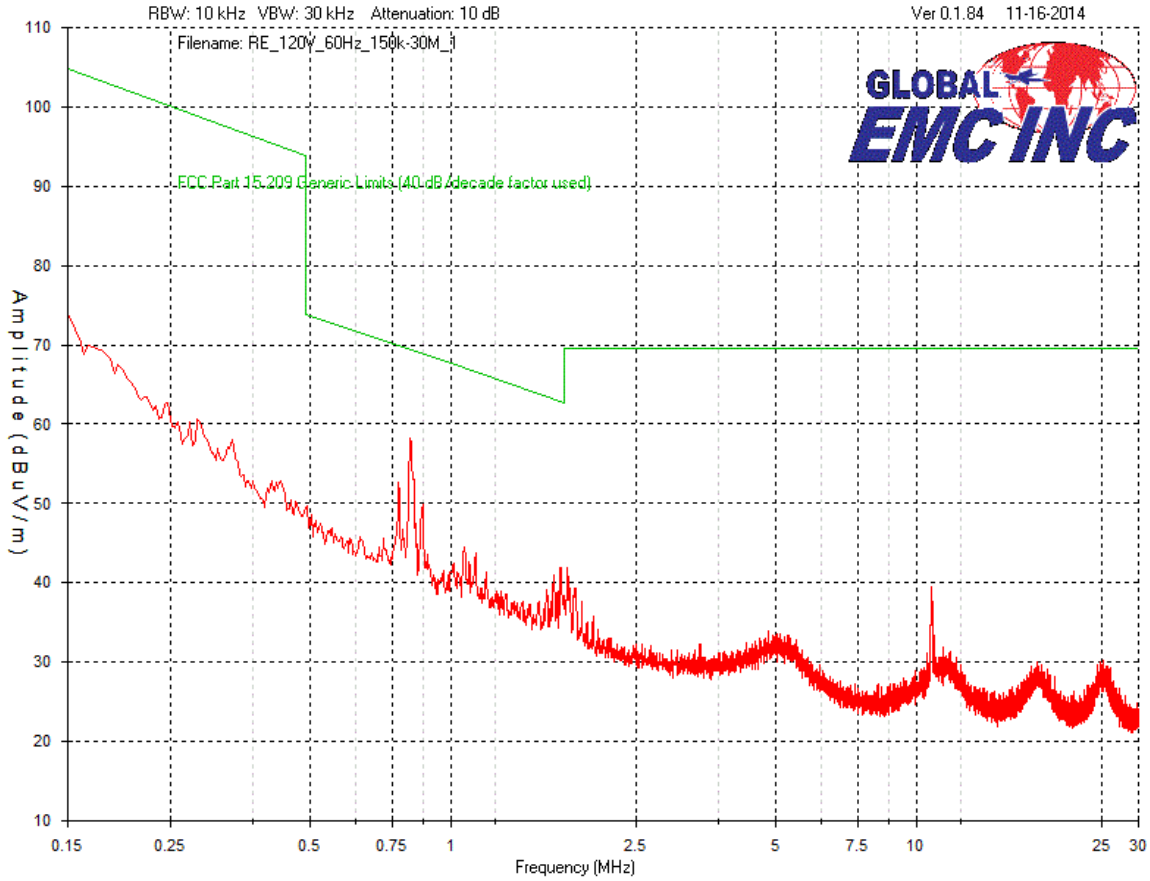
All transmitters in EUT are on and transmitting continuous modulated data at maximum power.

The measurement distance is 3m.

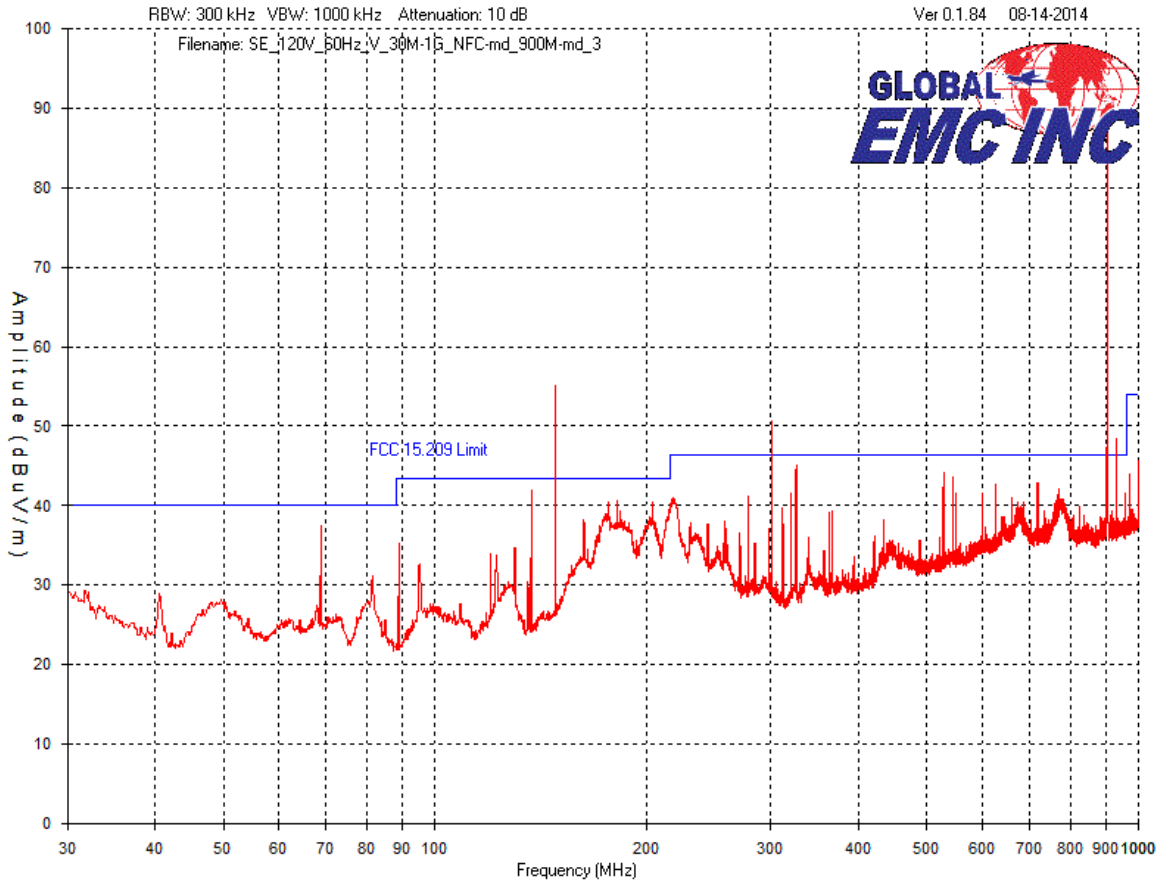
Peak Emissions Graph
9 kHz to 150 kHz



Peak Emissions Graph
150 kHz to 30 MHz

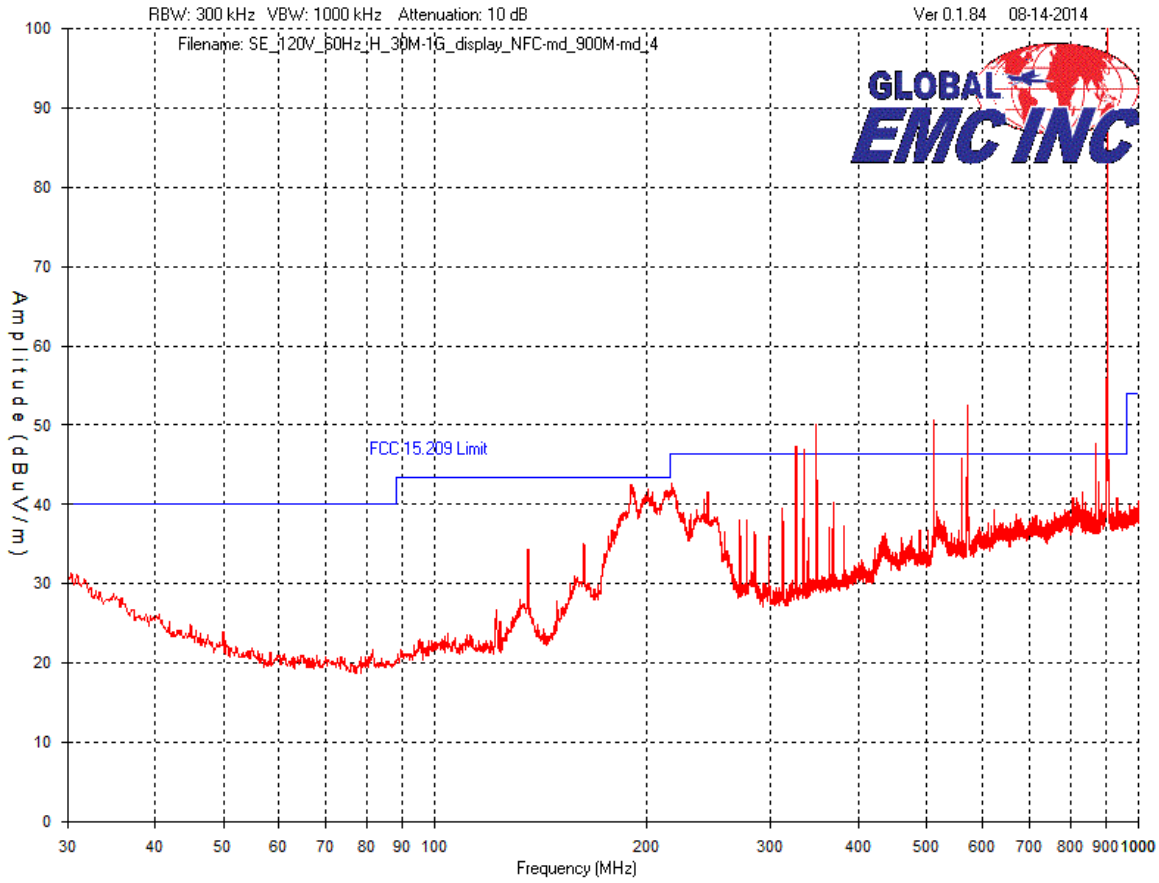


Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz



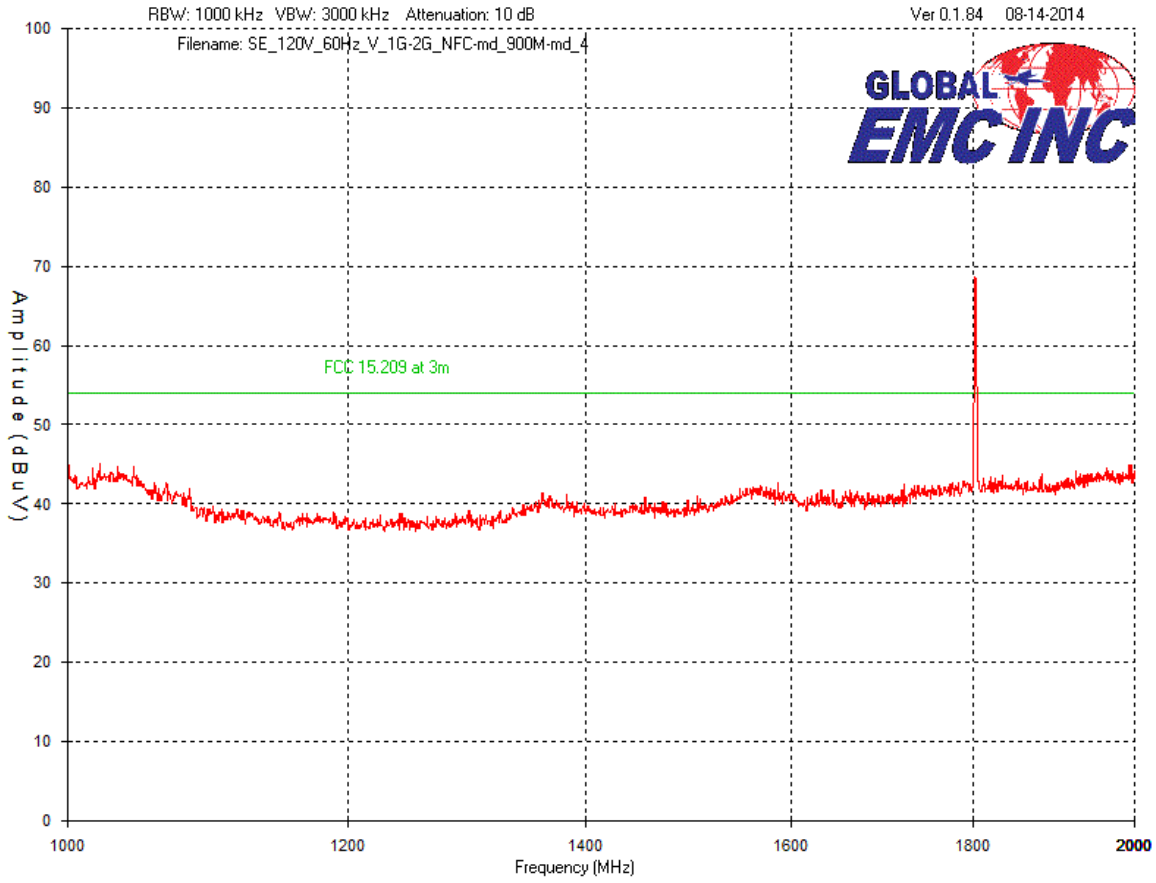
Please reference final tabular data in *Table 2* (page 60).

Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz

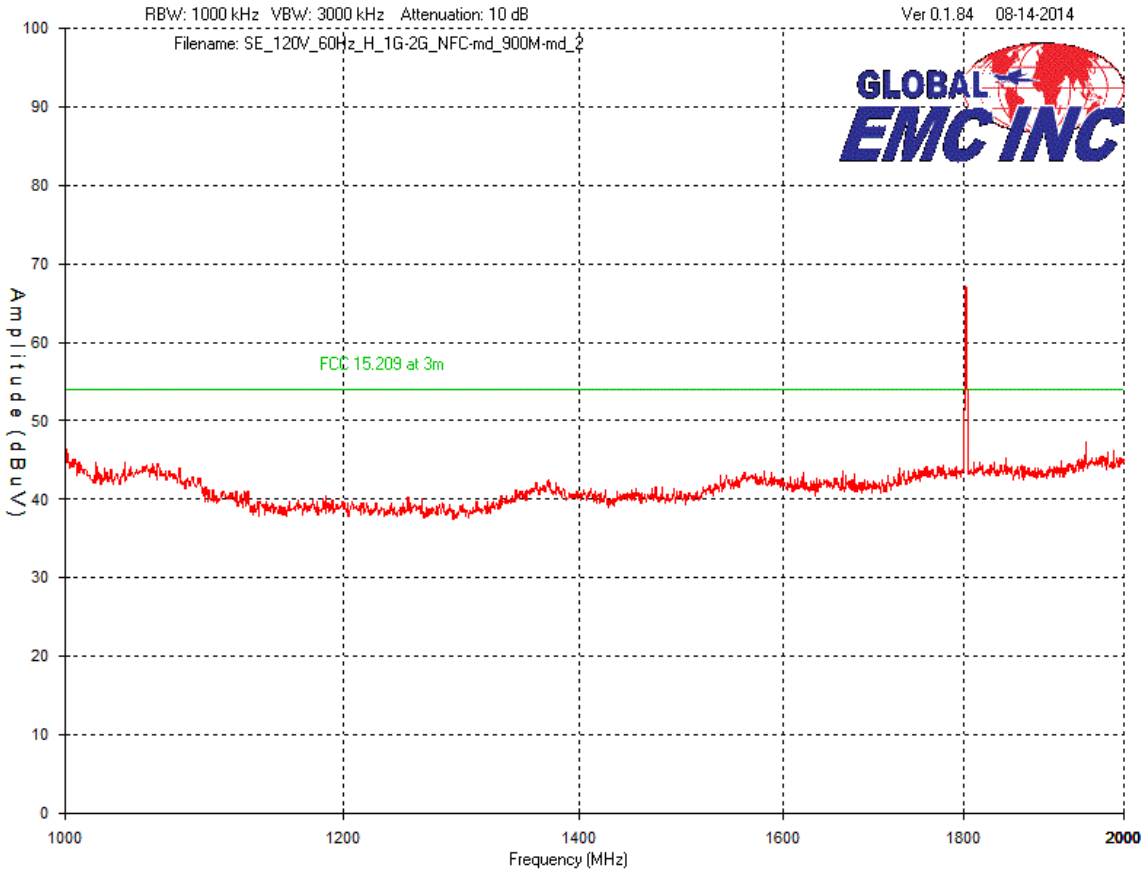


Please reference final tabular data in *Table 2* (page 60).

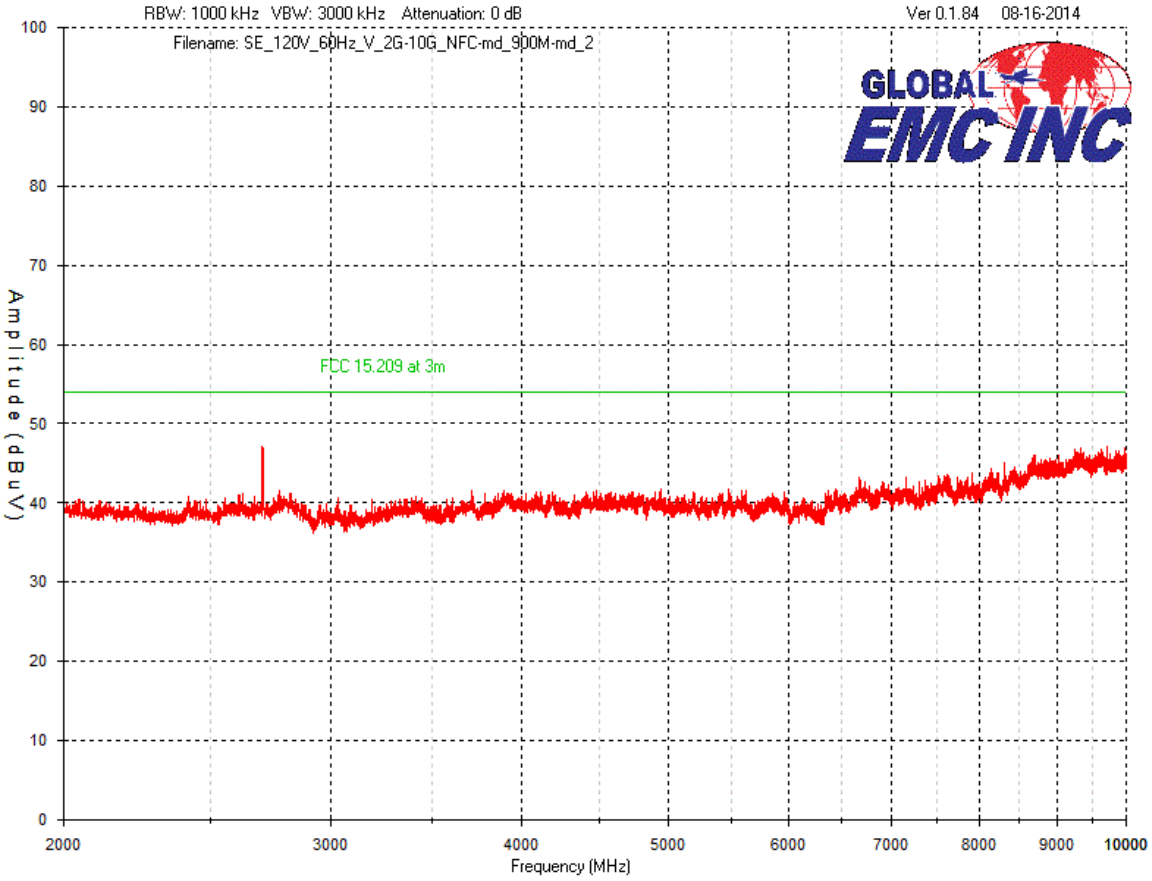
Peak Emissions Graph
Vertical Antenna Polarity
1 GHz to 2 GHz



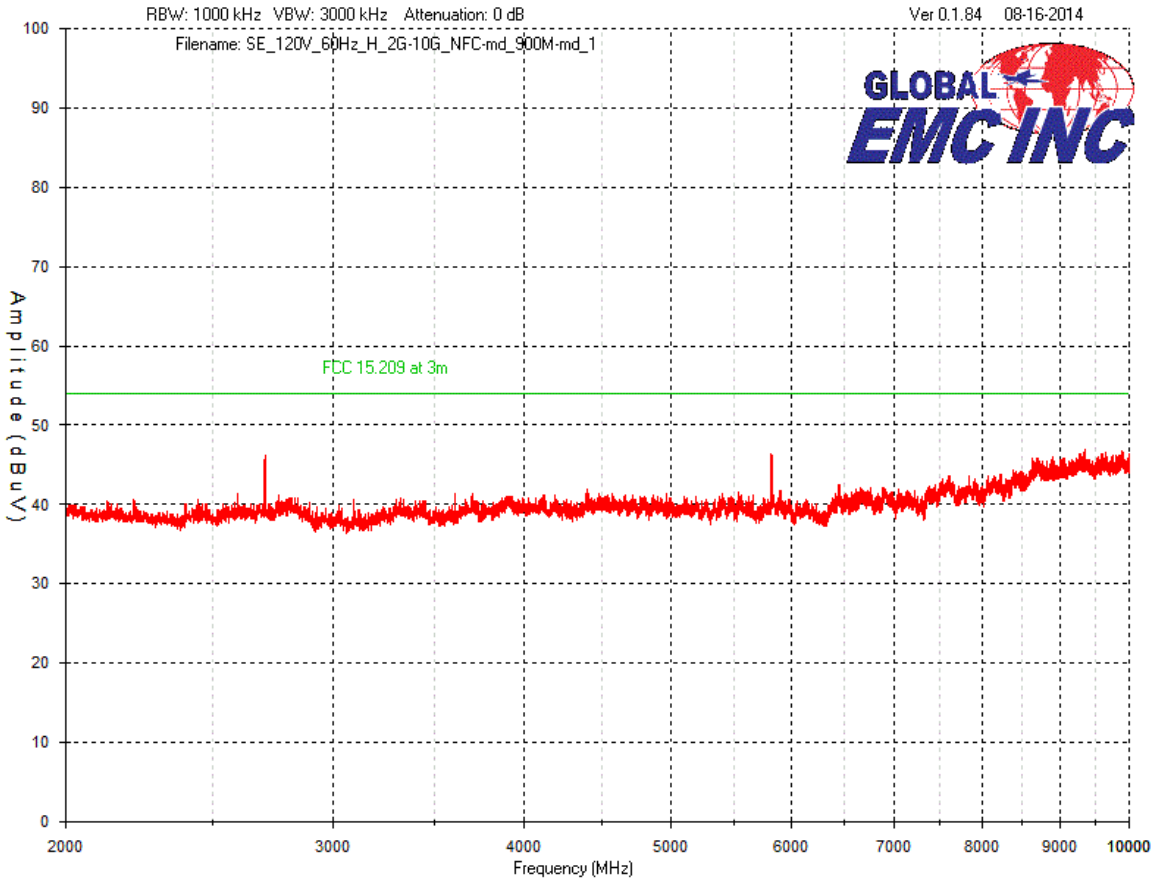
Peak Emissions Graph
Horizontal Antenna Polarity
1 GHz to 2 GHz



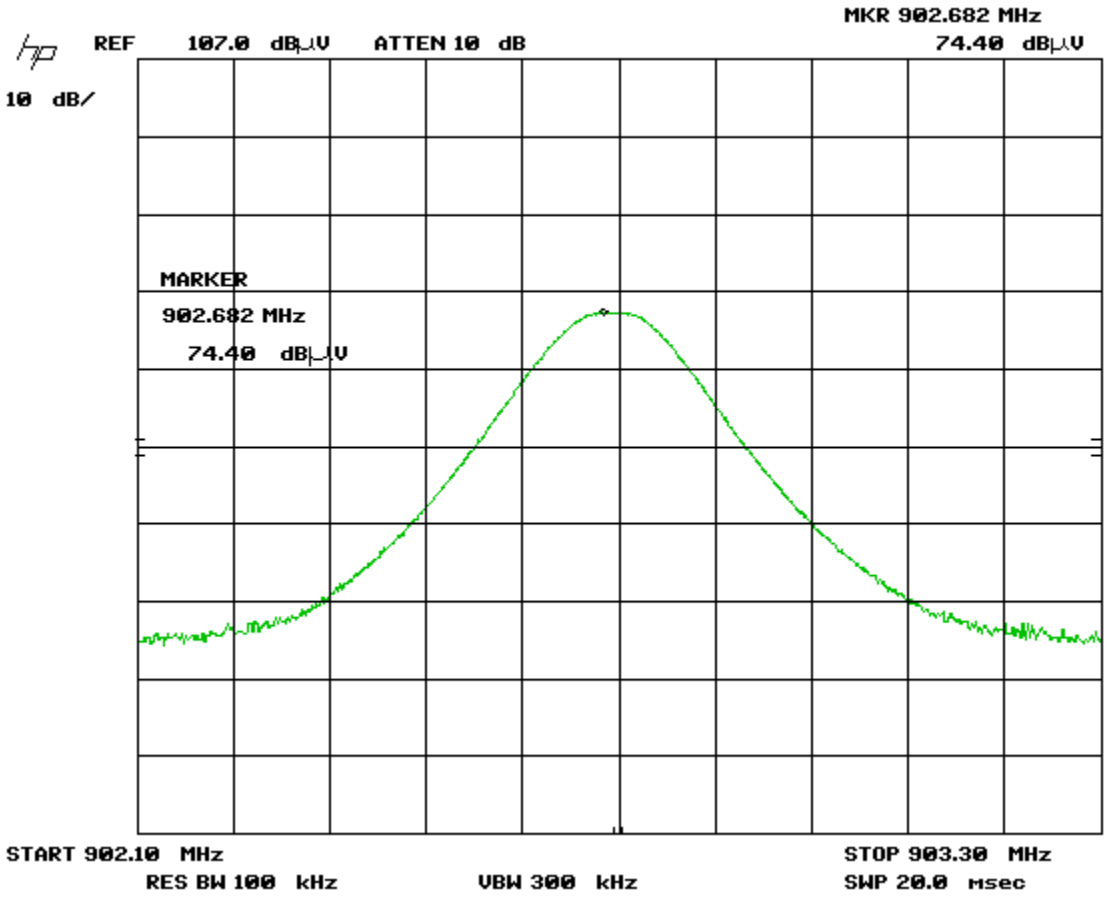
Peak Emissions Graph
Vertical Antenna Polarity
2 GHz to 10 GHz



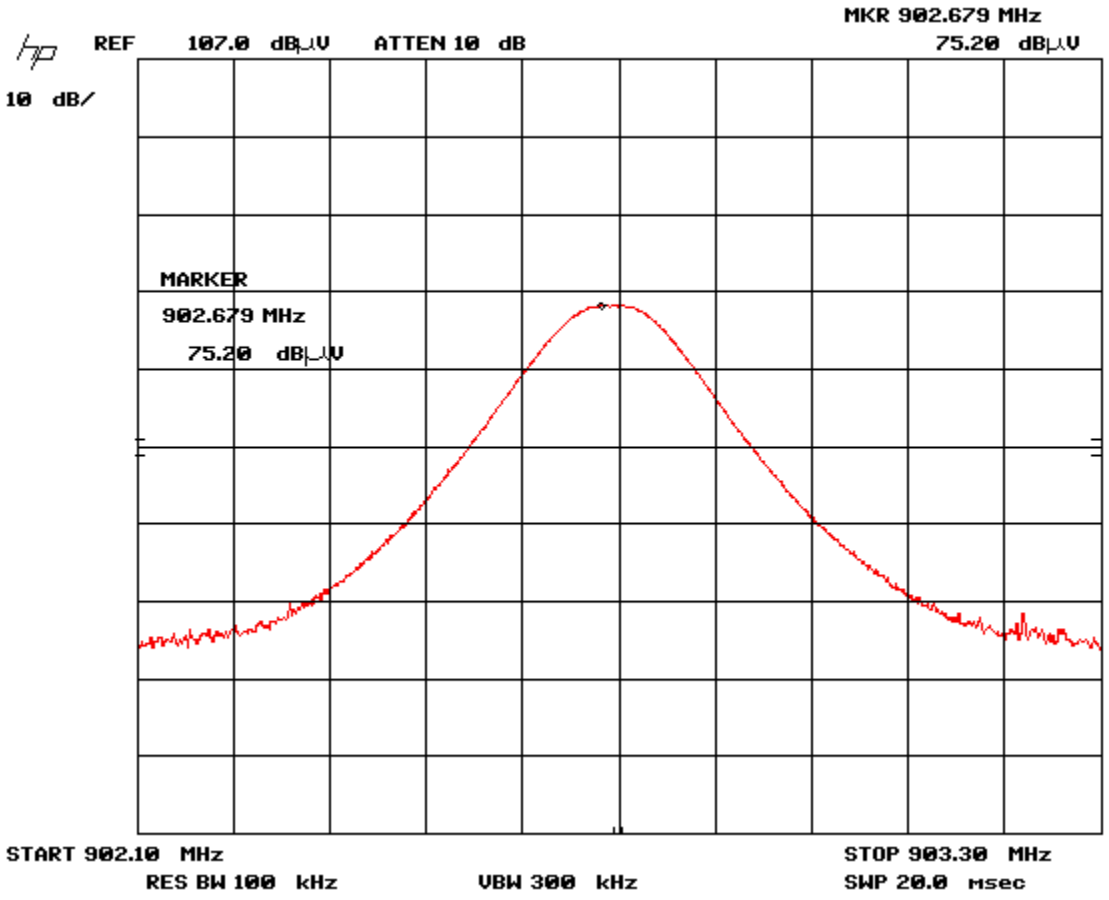
Peak Emissions Graph
Horizontal Antenna Polarity
2 GHz to 10 GHz



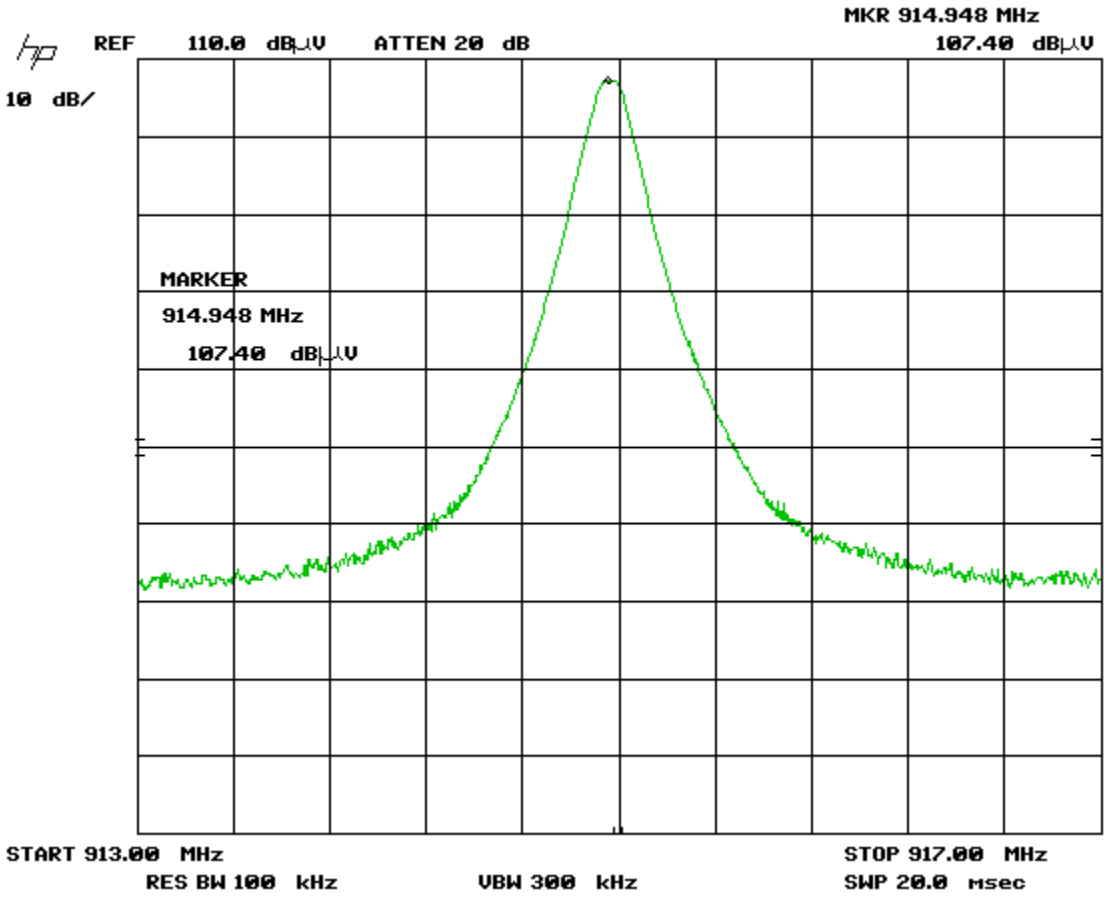
Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: Low Channe1



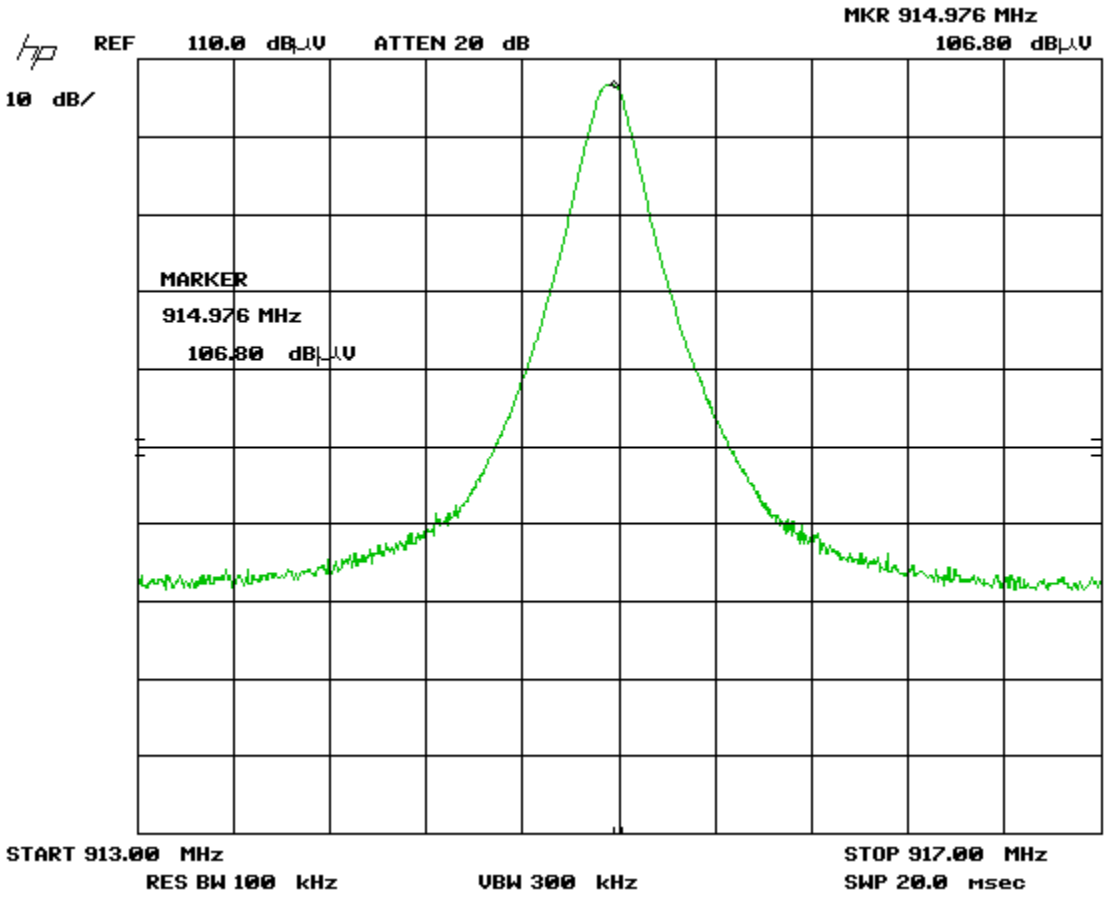
Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: Low Channe1



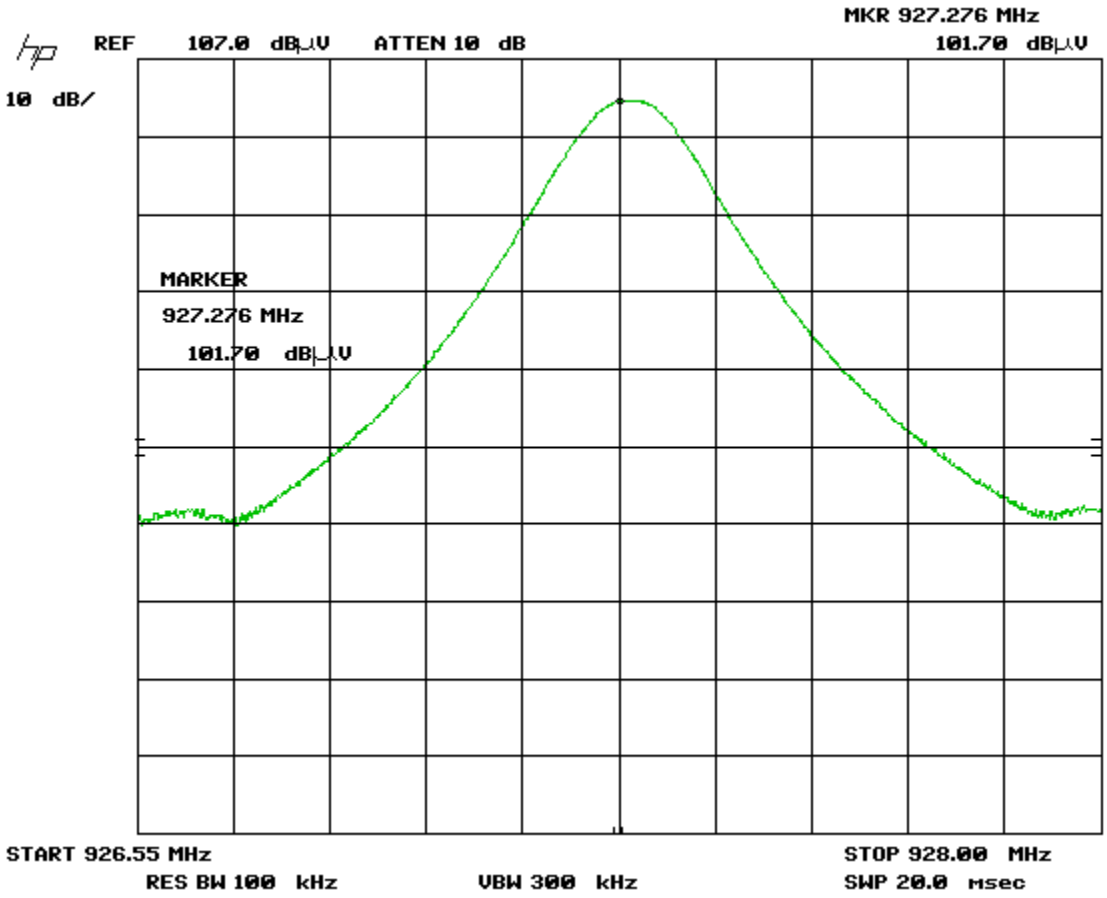
Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: Middle Channe1



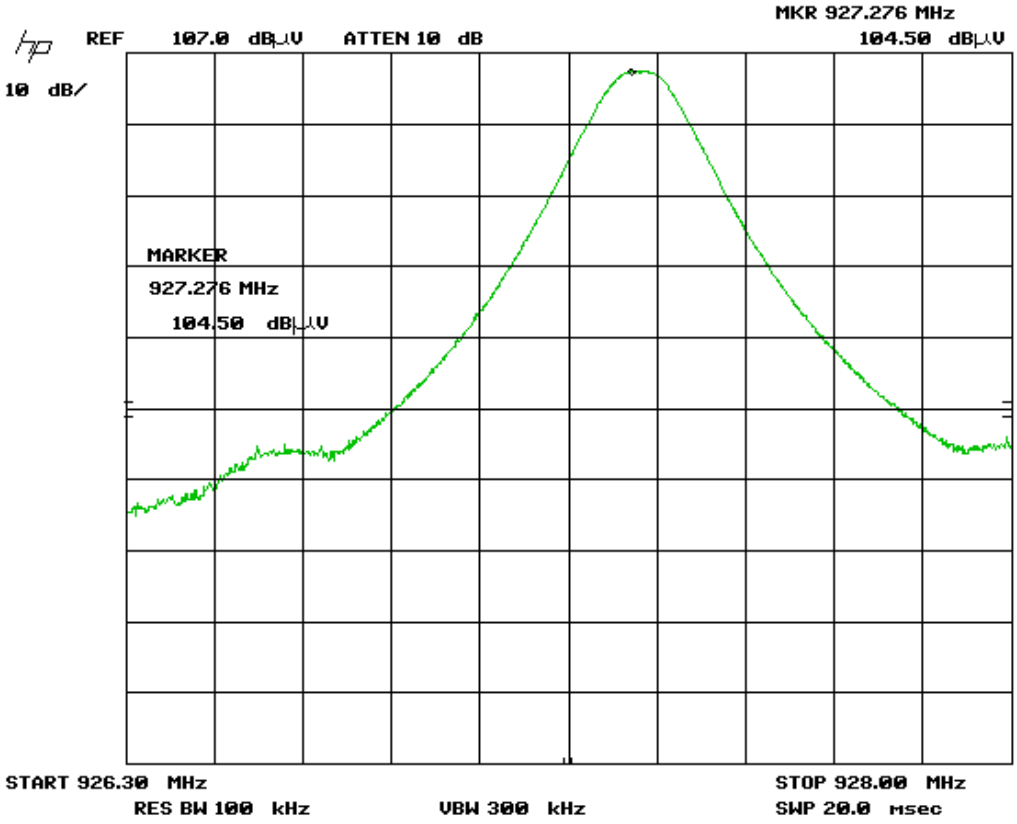
Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: Middle Channe1



Peak Emissions Graph, Vertical Antenna Polarity
EUT Output: High Channe1



Peak Emissions Graph, Horizontal Antenna Polarity
EUT Output: High Channe1



Final Measurements

Radiated Emissions - 15.247 - Table 1
Fundamental & Harmonics
3m measurement distance

Test Frequency (MHz)	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Pre-selector	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Low Channel – Fundamental Emissions											
902.7	Peak	Horz	75.2	23.4	2.3	3.0	0.0	103.9	125.20	21.3	Pass.
902.7	Peak	Vert	74.4	22.3	2.3	3.0	0.0	102.0	125.20	23.2	Pass.
Low Channel - Harmonics											
2nd Harmonic											
1805.4	Peak	Horz	70.3	30.2	3.6	0.0	34.0	70.1	83.9†	13.8	Pass
1805.4	Peak	Vert	73.0	28.7	3.6	0.0	34.0	71.3	82.0†	10.7	Pass
3rd Harmonic											
2708.1	Peak	Horz	49.8	26.6	4.7	0.0	33.8	47.3	73.90	26.6	Pass
2708.1	Avg	Horz	44.5	26.6	4.7	0.0	33.8	42.0	53.90	11.9	Pass
2708.1	Peak	Vert	49.0	26.5	4.7	0.0	33.8	46.4	73.90	27.5	Pass
2708.1	Avg	Vert	41.4	26.5	4.7	0.0	33.8	38.8	53.90	15.1	Pass
Harmonics above the 3rd are under the limits and the noise floor.											
Mid channel – Fundamental Emissions											
915	Peak	Horz	106.8	23.4	2.3	0.0	29.9	102.6	125.2	22.6	Pass
915	Peak	Vert	107.4	22.3	2.3	0.0	29.9	102.1	125.2	23.1	Pass
Mid channel - Harmonics											
2nd Harmonic											
1830	Peak	Horz	65.6	30.1	3.7	0.0	34.0	65.4	82.6†	17.2	Pass
1830	Peak	Vert	69.2	28.7	3.7	0.0	34.0	67.6	82.1†	14.5	Pass
3rd Harmonic											
2745	Peak	Horz	53.2	26.8	4.7	0.0	33.8	50.9	73.90	23.0	Pass
2745	Avg	Horz	50.3	26.8	4.7	0.0	33.8	48.0	53.90	5.9	Pass
2745	Peak	Vert	50.7	26.8	4.7	0.0	33.8	48.4	73.90	25.5	Pass
2745	Avg	Vert	41.3	26.8	4.7	0.0	33.8	39.0	53.90	14.9	Pass
Harmonics above the 3rd are under the limits and the noise floor.											
High Channel – Fundamental Emissions											
927.3	Peak	Horz	104.5	23.6	2.3	6.0	29.9	106.5	125.2	18.7	Pass
927.3	Peak	Vert	101.7	22.5	2.3	6.0	29.9	102.6	125.2	22.6	Pass

High Channel – Harmonics											
2nd Harmonic											
1854.6	Peak	Horz	68.3	30.1	3.7	0.0	33.9	68.2	86.5†	18.3	Pass
1854.6	Peak	Vert	70.6	28.6	3.7	0.0	33.9	69.0	82.6†	13.6	Pass
3rd Harmonic											
2781.9	Peak	Horz	53.0	26.7	4.8	0.0	33.8	50.7	73.90	23.2	Pass
2781.9	Avg	Horz	49.0	26.7	4.8	0.0	33.8	46.7	53.90	7.2	Pass
2781.9	Peak	Vert	50.9	26.6	4.8	0.0	33.8	48.5	73.90	25.4	Pass
2781.9	Avg	Vert	46.5	26.6	4.8	0.0	33.8	44.1	53.90	9.8	Pass
Harmonics above the 3rd are under the limits and the noise floor.											

† 2nd harmonic frequency is not in the restricted bands specified in 15.205. Limit shown is 20 dB from the fundamental emission measured.

Radiated Emissions - 15.247 - Table 2
Other spurious measurements
3m measurement distance

Test Frequency (MHz)	Detection mode	Raw signal dB(µV)	Antenna factor (dB)	Attenuator factor (dB)	Cable loss dB + Pre-selector	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Vertical Antenna Polarity										
148.4	QP	43.9	9	6	0.9	-30.1	29.7	43.5	13.8	Pass
300.9	QP	44.9	13.8	6	1.3	-30.2	35.8	46.4	10.6	Pass
930.3	QP	35.1	22.5	6	2.3	-29.9	36	46.4	10.4	Pass
326.1	QP	36.2	14.2	6	1.4	-30.3	27.5	46.4	18.9	Pass
136.9	Peak	57.5	7.6	6	0.9	-30	42	43.5	1.5	Pass
528.7	Peak	48.2	18.1	6	1.8	-29.9	44.2	46.4	2.2	Pass
Horizontal Antenna Polarity										
570.0	QP	34.1	19.4	6	1.8	-29.9	31.4	46.4	15	Pass
511.4	QP	30.4	18.5	6	1.7	-29.9	26.7	46.4	19.7	Pass
348.5	QP	28.4	15.4	6	1.4	-30.3	20.9	46.4	25.5	Pass
869.8	QP	31.4	22.9	6	2.2	-29.9	32.6	46.4	13.8	Pass
325.9	QP	44.9	14.6	6	1.4	-30.2	36.7	46.4	9.7	Pass
333.9	QP	29.2	14.8	6	1.4	-30.3	21.1	46.4	25.3	Pass
217.3	QP	47.8	11.1	6	1.1	-30.2	35.8	46.4	10.6	Pass

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	85650A	HP	Jan. 23, 2013	Jan. 23, 2015	GEMC 170
Quasi-Peak Detector	8566B	HP	Jan. 22, 2013	Jan. 22, 2015	GEMC 169
Loop Antenna 30Hz – 1MHz	EM 6871	Electro-Metrics	Feb. 5, 2013	Feb. 5, 2015	GEMC 70
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 5, 2013	Feb. 5, 2015	GEMC 71
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Q-Par Horn 1.5GHz -18 GHz	6878/24	Q-par	Sept. 10, 2014	Sept. 10, 2016	GEMC 6365
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
Pre-amp 1-26GHz	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Radiated Emissions – Verification Testing With Display

Purpose

The purpose of this test is to verify that the emissions of the product remain within the relevant limits when the RF transmitter is connected to the display panels to form a full system. See *Justifications, Descriptions, Deviations & Notes* section for more details regarding these configurations. As the display panels are unintentional radiators only, and the full system is intended to be used in commercial, industrial or business environments only, it is tested to against FCC Subpart B, "Class A" limits.

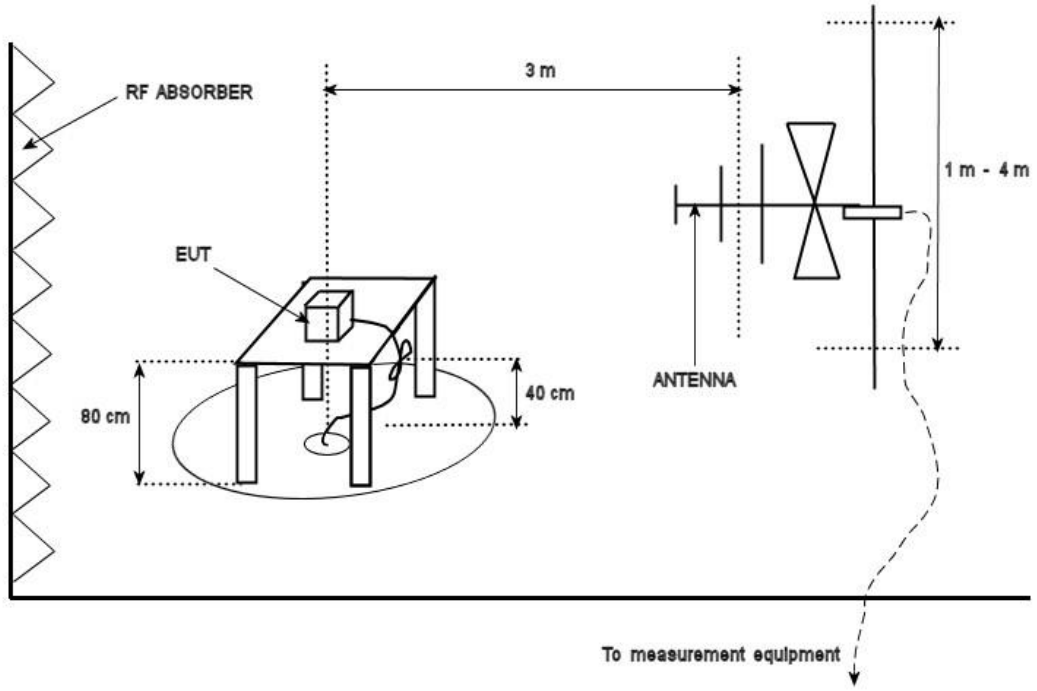
Limit(s) and Method

The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.109(g):

30 MHz – 230 MHz, 40 dBuV/m at 10m, 50.5 dBuV/m at 3m[1]
230 MHz – 1000 MHz, 47 dBuV/m at 10m, 57.5 dBuV/m at 3m[1]
Above 1000 MHz[3], 300 uV/m (49.5 dBuV/m) at 10m, 60 dBuV/m at 3m[2]

[1]Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector
[3]The frequency range scanned was in accordance 15.33(b)

Typical Radiated Emissions Setup



Note: In accordance with FCC Part 15, section 15.31(f)(1) testing was performed at a 3 meter test distance and an extrapolation factor of 10.5 dB was applied.

Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

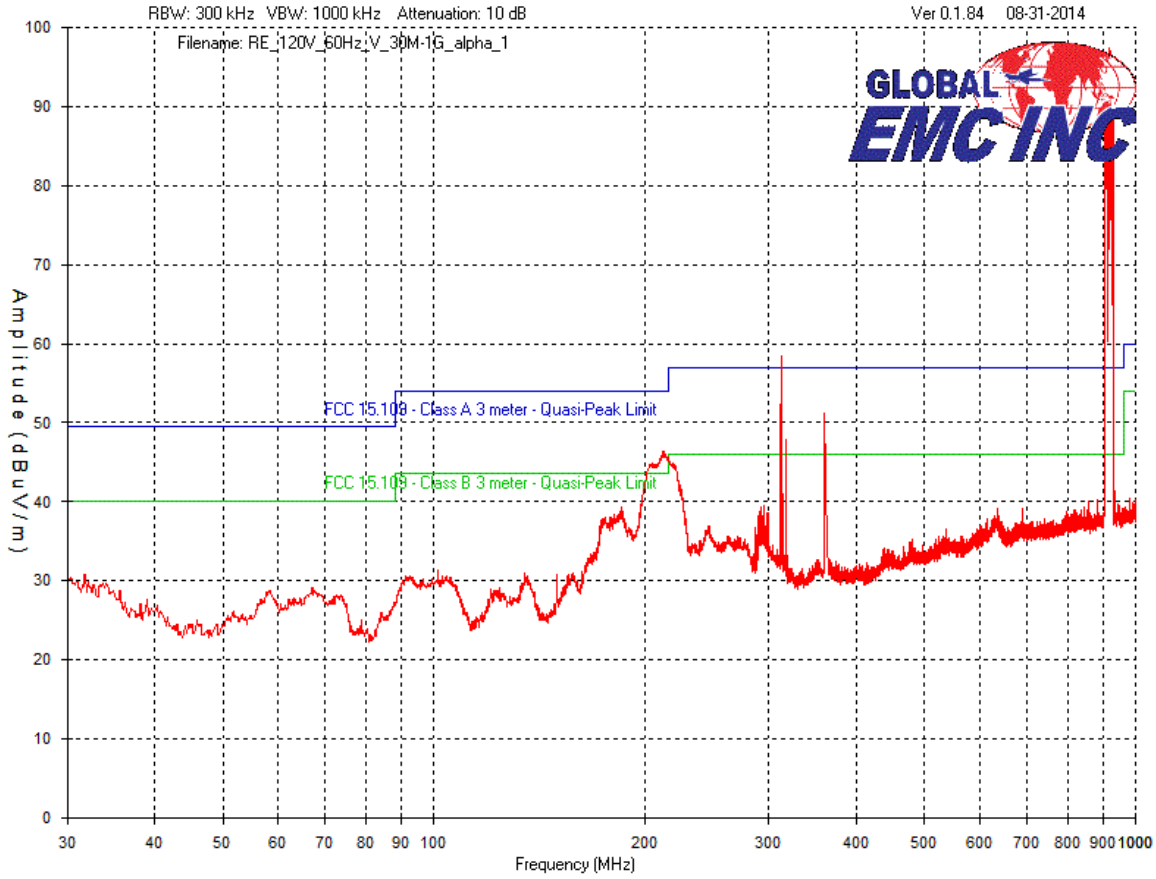
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

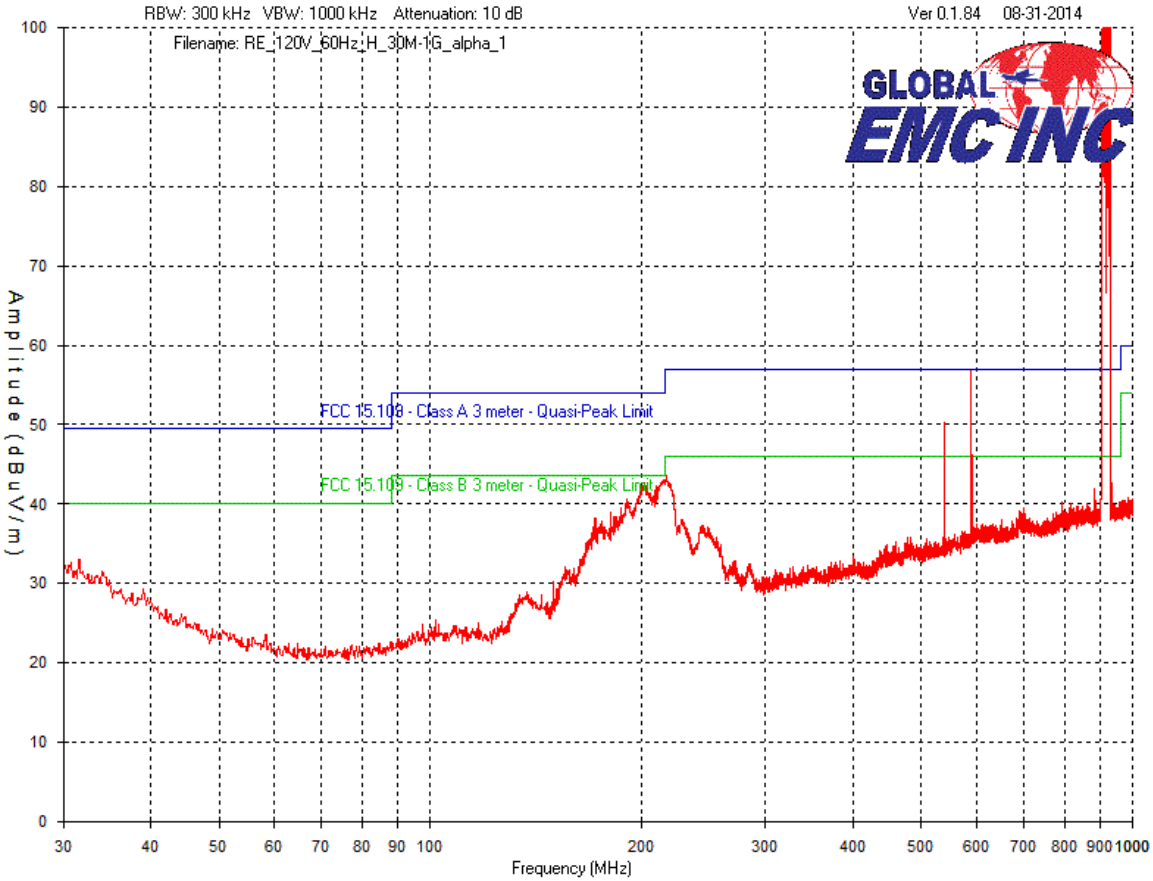
The EUT was scanned with the 15.247 transmitter on.

See *Final Measurements* section for measurements.

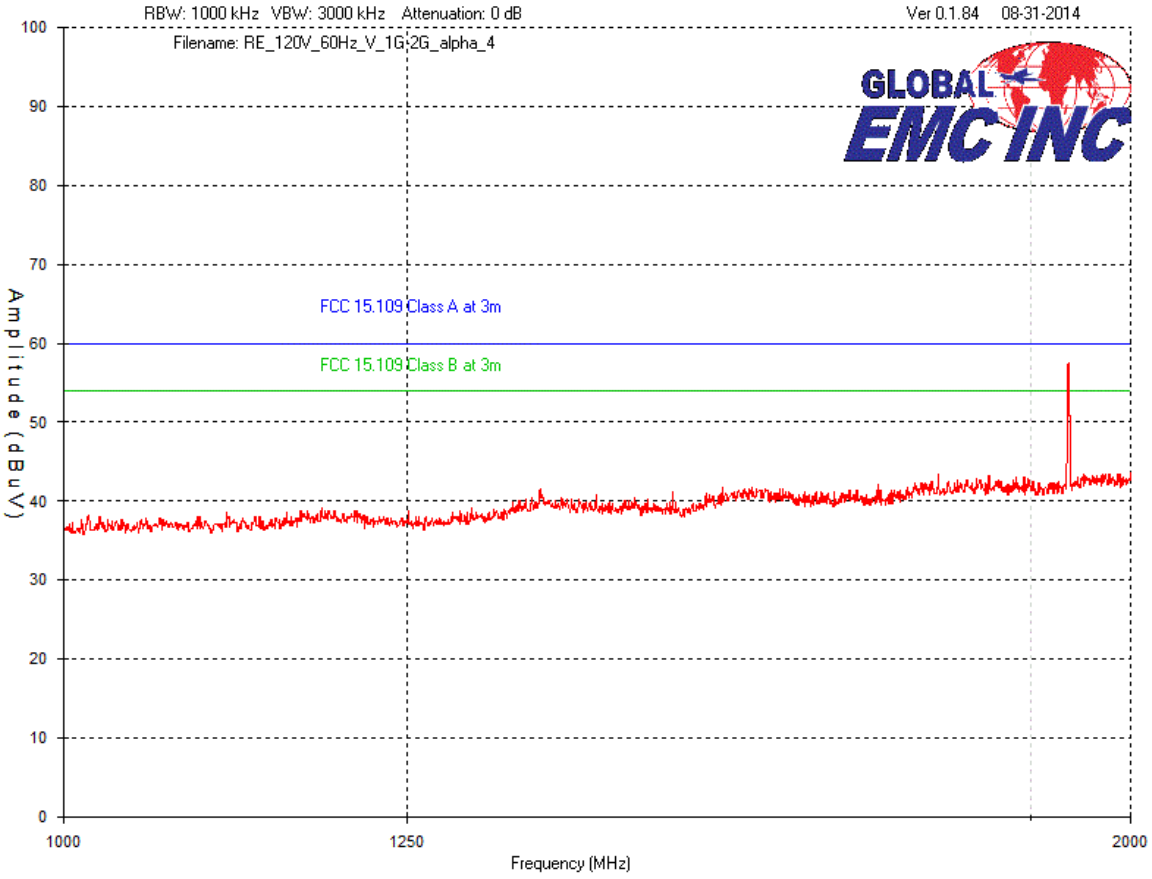
Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz
With Alpha-numeric Display



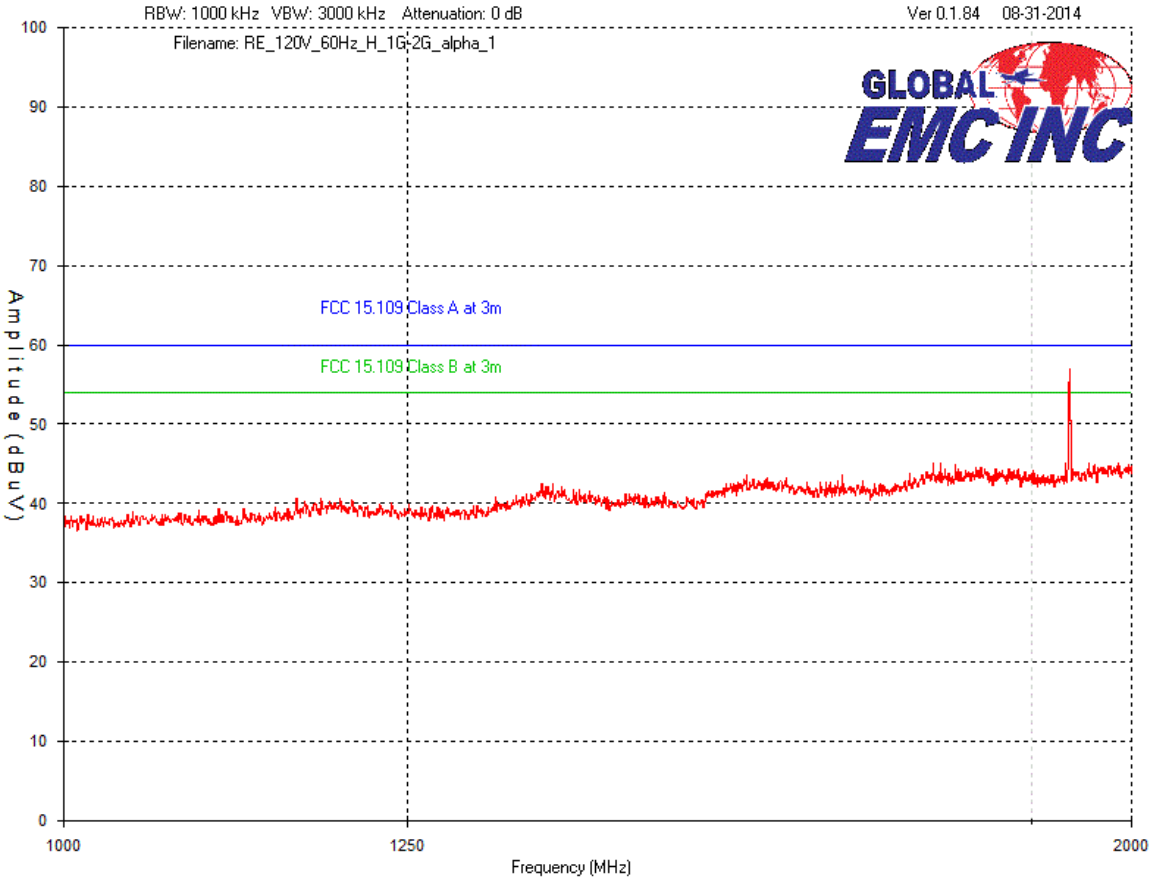
Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz
With Alpha-numeric Display



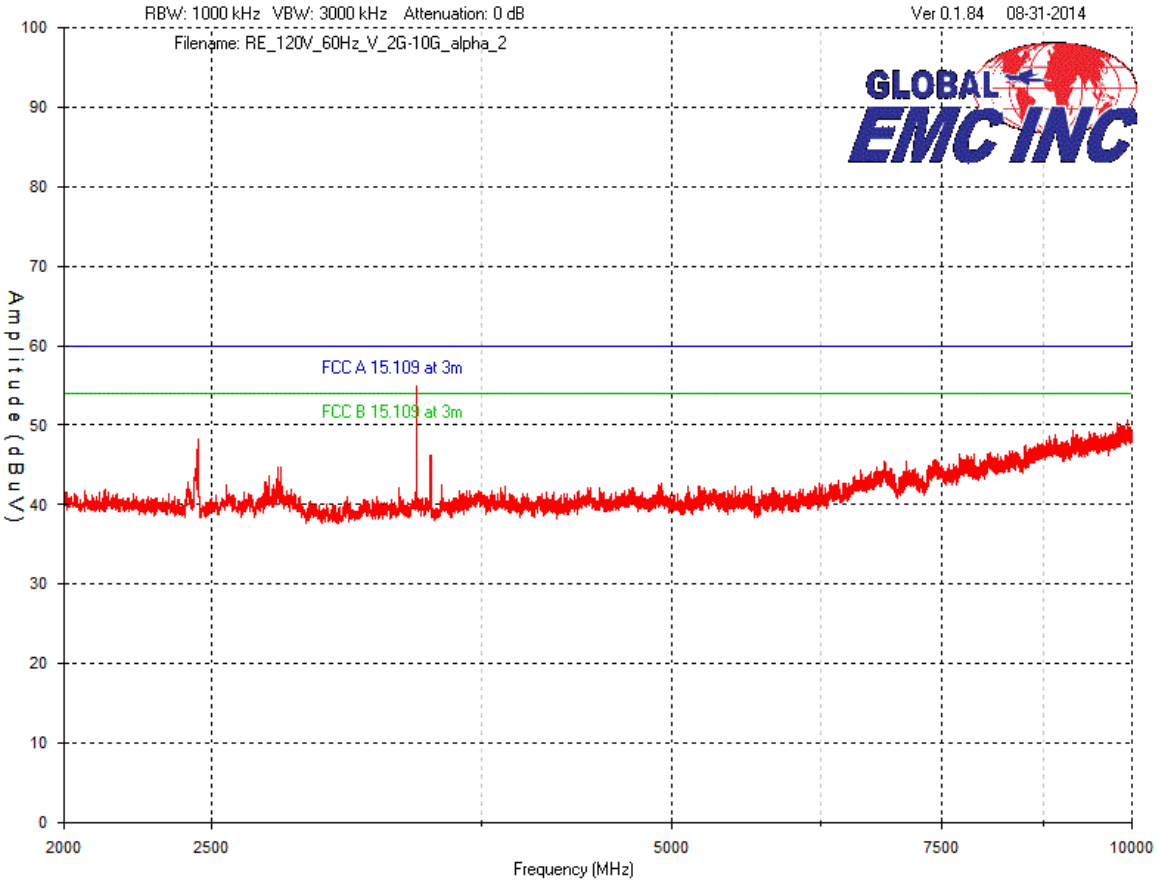
Peak Emissions Graph
Vertical Antenna Polarity
1 GHz to 2 GHz
With Alpha-numeric Display



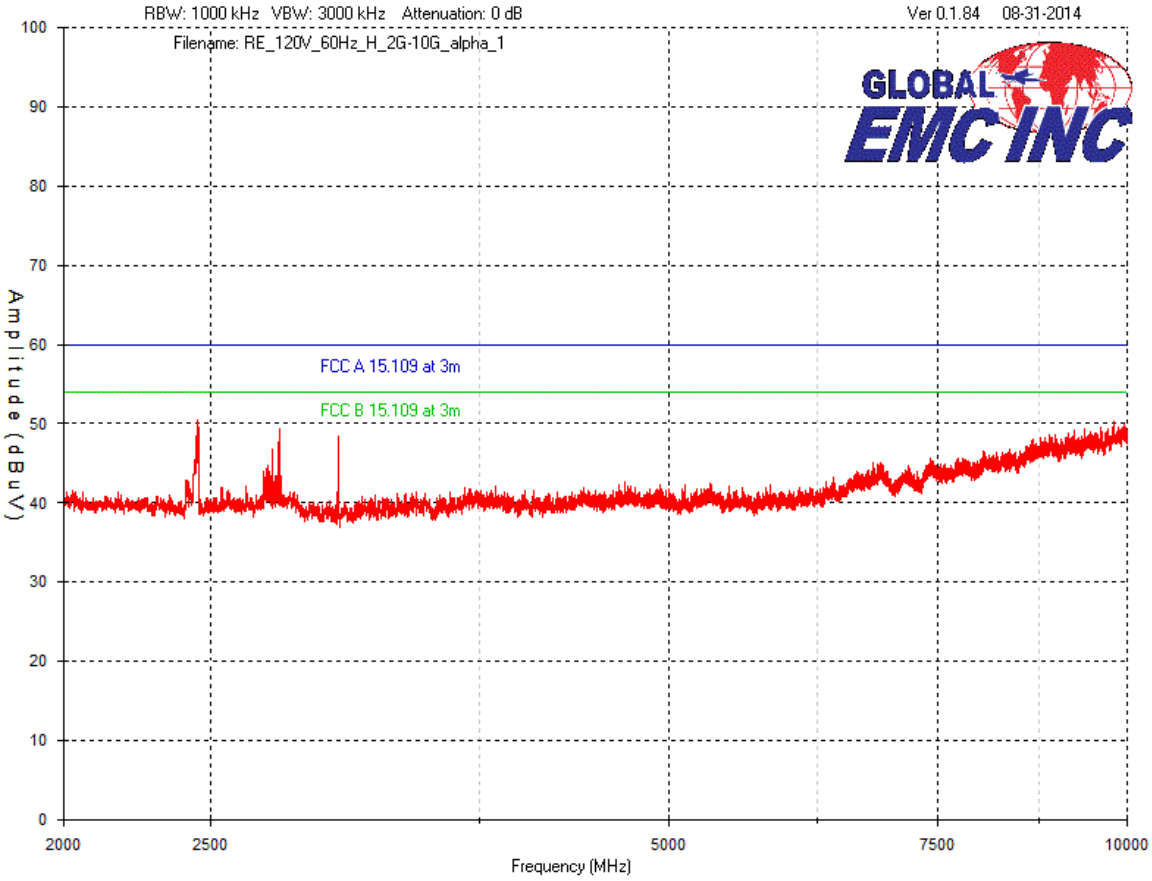
Peak Emissions Graph
Horizontal Antenna Polarity
1 GHz to 2 GHz
With Alpha-numeric Display



Peak Emissions Graph
Vertical Antenna Polarity
2 GHz to 10 GHz
With Alpha-numeric Display



Peak Emissions Graph
Horizontal Antenna Polarity
2 GHz to 10 GHz
With Alpha-numeric Display



Final Measurements

Radiated Emissions - 15.109
Class A, 3m measurement distance
With Alpha-numeric Display

Test Frequency (MHz)	Detection mode (Peak /QP/Avg.)	Received signal (dBµV)	Antenna factor (dB)	Atten. (dB)	Cable loss (dB)	Pre-Amp (dB)	Emission Level (dBuV/m)	Emission limit dB(µV/m)	Margin (dB)	Result
Vertical Antenna Polarity										
312.7	QP	32.8	14.1	6	1.3	-30.3	23.9	56.9	33	Pass
313.2	QP	32.3	14.1	6	1.3	-30.3	23.4	56.9	33.5	Pass
359.9	QP	29.5	15.3	6	1.4	-30.3	21.9	56.9	35	Pass
212.3	Peak	58.6	11	6	1.1	-30.2	46.5	54	7.5	Pass
294.7	Peak	49.4	13.1	6	1.3	-30.2	39.6	56.9	17.3	Pass
31.7	Peak	39.3	15.1	6	0.5	-30	30.9	49.6	18.7	Pass
3405.3	Peak	56	27	0	5.6	-33.8	54.8	80	25.2	Pass
3405.3	Avg.	31.6	27	0	5.6	-33.8	30.4	60	29.6	Pass
Horizontal Antenna Polarity										
589.4	QP	30.1	20.2	6	1.9	-29.8	28.4	56.9	28.5	Pass
538.2	QP	28.8	18.9	6	1.8	-30	25.5	56.9	31.4	Pass
216.5	Peak	55.6	11.1	6	1.1	-30.2	43.6	56.9	13.3	Pass
202.0	Peak	55.3	10.6	6	1.1	-30.2	42.8	56.9	14.1	Pass
197.8	Peak	53.7	10.5	6	1.1	-30.2	41.1	56.9	15.8	Pass
31.6	Peak	39.2	17.3	6	0.5	-30	33	49.6	16.6	Pass

Notes:

Peak = Peak reading
QP = Quasi-Peak reading.
Avg. = Average reading

Where peak readings are under quasi-peak or average limits, the EUT is deemed to have passed the requirements and no respective readings are necessary.

Emission spikes at ~900MHz and 1800MHz are the fundamental and harmonic emissions from the intentional radiator, and evaluated separately in the *Radiated Emissions – 15.247, 15.209* section.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	85650A	HP	Jan. 23, 2013	Jan. 23, 2015	GEMC 170
Quasi-Peak Detector	8566B	HP	Jan. 22, 2013	Jan. 22, 2015	GEMC 169
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Horn Antenna	6878/24	Q-par	Sept. 10, 2014	Sept. 10, 2016	GEMC 6365
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
Pre-amp 1-26GHz	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207
Method is as defined in ANSI C64:2003

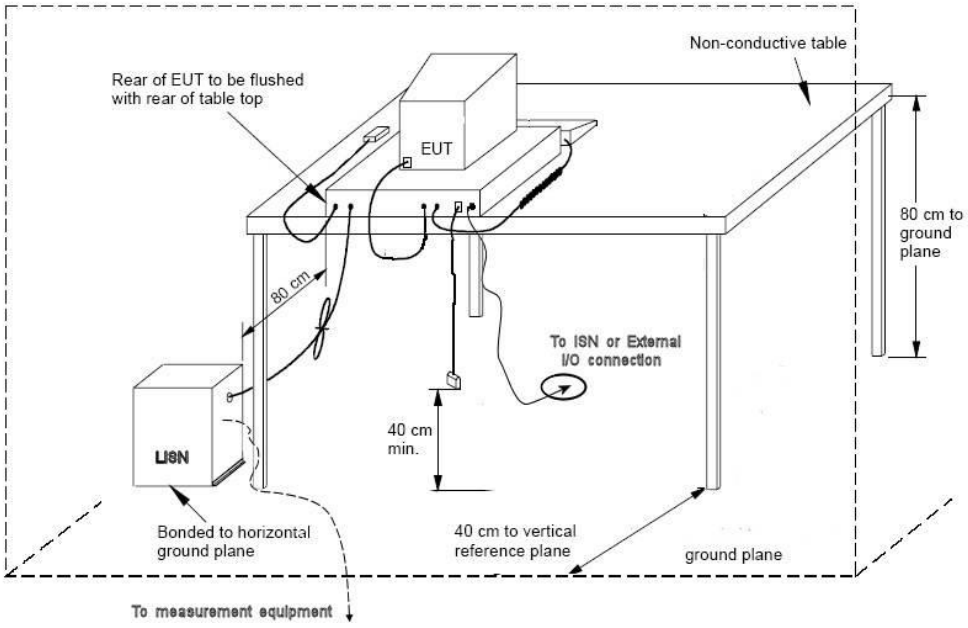
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Typical Setup Diagram



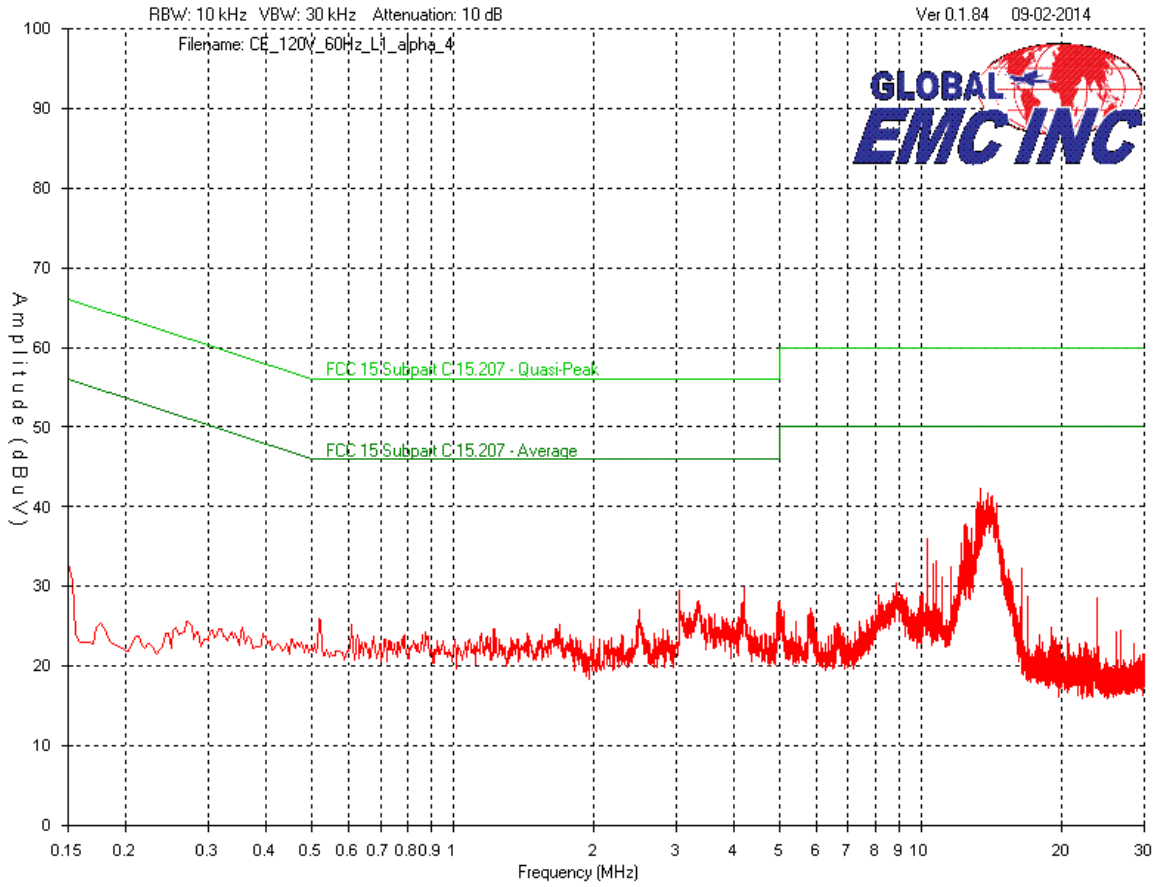
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

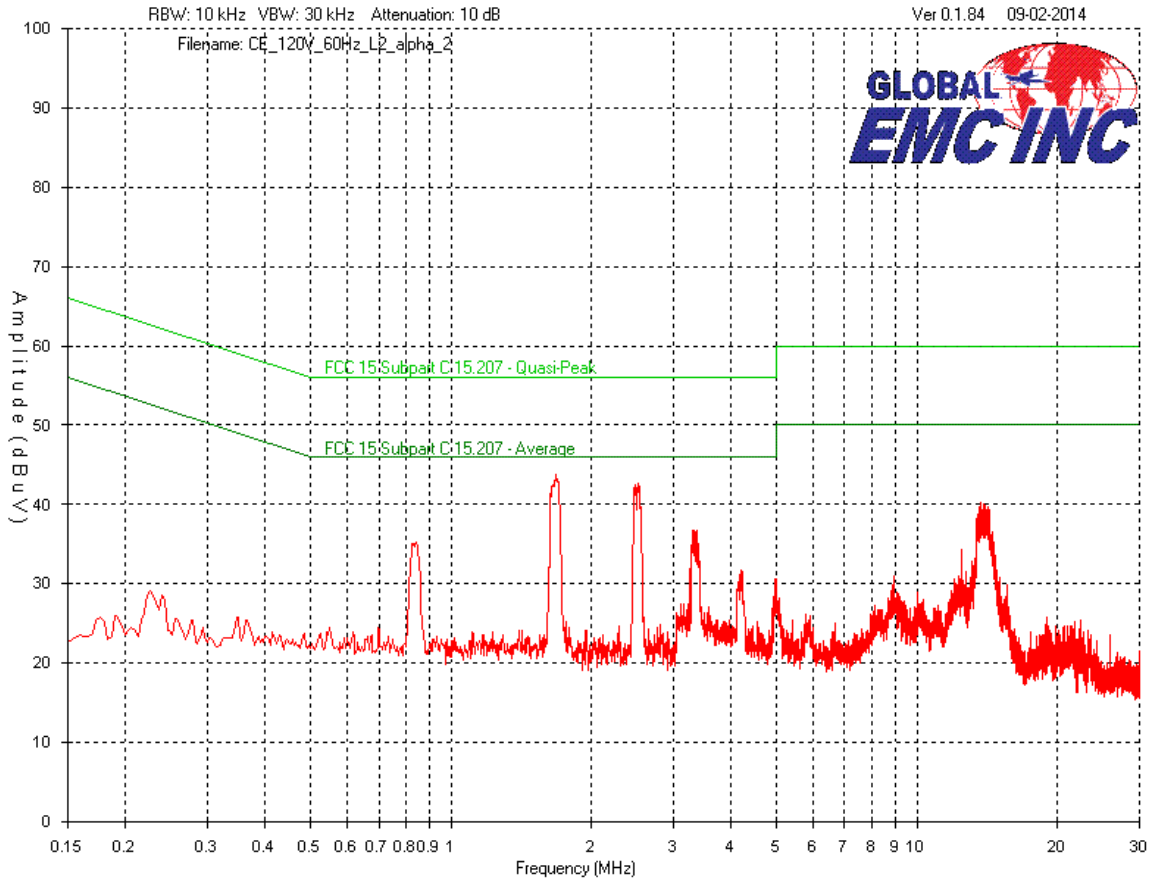
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. Power line conducted emissions were performed with the transmitter transmitting with constant modulated data at maximum power.

Peak Emissions Graph - Line 1
With Alpha-Numeric Display
$120V_{AC}$, 60Hz



Peak Emissions Graph - Line 2
With Alpha-Numeric Display
$120V_{AC}$, 60Hz



Final Measurements

Emissions Table
With Alphanumeric Display
$120V_{AC}$, 60Hz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
13.5	Peak	31.9	10	0.2	0.1	42.2	60	50	17.8	7.8	Pass
13.9	Peak	31.5	10	0.2	0.1	41.8	60	50	18.2	8.2	Pass
13.2	Peak	30.4	10	0.2	0.1	40.7	60	50	19.3	9.3	Pass
13.3	Peak	30.1	10	0.2	0.1	40.4	60	50	19.6	9.6	Pass
13.1	Peak	29.4	10	0.2	0.1	39.7	60	50	20.3	10.3	Pass
12.5	Peak	27.6	10	0.2	0.1	37.9	60	50	22.1	12.1	Pass
Neutral Line											
1.68	Peak	33.6	10	0.1	0.1	43.8	56	46	12.2	2.2	Pass
2.53	Peak	32.4	10	0.1	0.1	42.6	56	46	13.4	3.4	Pass
3.38	Peak	26.6	10	0.1	0.1	36.8	56	46	19.2	9.2	Pass
13.7	Peak	30	10	0.2	0.1	40.3	60	50	19.7	9.7	Pass
0.841	Peak	25.1	10	0.1	0.1	35.3	56	46	20.7	10.7	Pass
3.26	Peak	21.8	10	0.1	0.1	32	56	46	24	14	Pass

Notes:

Peak = Peak readings
QP = Quasi-Peak readings
Avg. = Average readings

Where peak readings are under quasi-peak and/or average limits, the EUT passes the respective requirements, and no quasi-peak or average measurements are required.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	2013-11-15	2015-11-15	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	2013-02-06	2015-02-06	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

General EUT Description

Client Details	
Organization / Address	Elkay Manufacturing Co. 2222 Camden Ct. Oakbrook, Illinois United States of America 60523
Contact	Rene Laude
Phone	708-786-5067
Email	rene.laude@elkay.com
EUT (Equipment Under Test) Details	
EUT Name / Model	EZS8WSLP (single level unit) EZSTL8WSLP (bi-level unit)
Mains input voltage range(s)	115V, 60Hz
Rated input current	4.2 A
Transmit Frequencies	902.7 – 927.3 MHz
Basic EUT functionality description	The EUT is a drinking fountain and bottle filling station with display capabilities. It can wirelessly communicate with a base station at the 900 MHz range. The part with the wireless capabilities is connected to an alpha-numeric display, which does not have wireless capabilities itself.
Modes of operation	On mode. Unit is typically always on after installation.
Available connectors on EUT	None
Dimensions of product	L: 48cm, W: 47cm, H: 100cm (base including display) L: 48cm, W: 47cm, H: 51cm (base only)
Separation distance from operator	20cm

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see photo exhibits.